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THE NEW STAR IN PERSEUS.

By A. FOWLER, F.R.A.S.

ON the early morning of February 22nd, Dr. Anderson, of Edinburgh, observed a star of magnitude 2.7 in the Milky Way in the constellation Perseus, in a region where no star had been previously known to exist. Another "new star"—to be henceforth known as Nova Persei, in accordance with the usual custom—had, therefore, appeared in the heavens, and, thanks to Dr. Anderson's speedy transmission of the news to the Royal Observatory at Edinburgh, the whole astronomical world was soon actively interested in the new arrival.

At the time of discovery the star already surpassed in brightness all the novæ that had been observed since 1866, and the fact that on the evening of the 22nd it had reached the first magnitude encouraged the hope that it might even rival the famous new stars of 1572 and 1604, which are inseparably associated with the names of Tycho Brahe and Kepler. This hope, however, was not realised, for in the course of a few days it was seen that the star was distinctly on the down grade. Still Nova Persei ranks as the brightest star of its class which

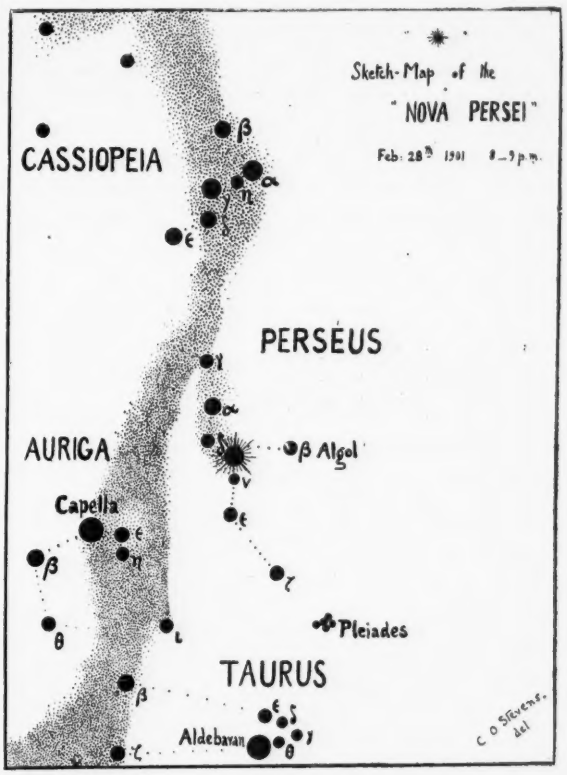

FIG. 1.—Chart showing position of Nova Persei.

has appeared for nearly three centuries, and is almost the only one during this period which has been certainly observed before attaining its greatest brilliancy.

One of the first questions which naturally arises is how long was the star bright before its discovery? The wonderful photographic "star traps" organised by Prof. Pickering at Harvard and Arequipa, by which all the principal stars visible every fine night are duly registered, give a very definite answer to this question. The Harvard plates taken on the 19th of February gave no indications of any star as bright as the 11th magnitude in the place now occupied by Nova Persei, so that at that time there was certainly no star of a ten-thousandth part of the luminosity of that which was seen three days later. It is, of course, impossible to say what the actual brightness was before this amazingly sudden and tremendous outburst of energy took place, and equally impossible to believe that there was no body at all in that part of space prior to the conflagration.

During the early stages of visibility of the new star the weather in this country was by no means favourable, and many who wished to carry on investigations had to be contented with occasional glimpses. A few such glimpses at Kensington on the night of the 22nd showed that the star was of at least first magnitude, but no photographs could be taken there before the 25th. At Edinburgh, however, Dr. Copeland and his assistants

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were a little more fortunate, and noted that on the 22nd, at 6.58, G.M.T., the star was about 0.3 mag. brighter than α Tauri, and at 8.10 p.m. equal to Procyon, while on the 23rd, at 8.10 p.m., the nova exceeded Capella by 0.2 mag. On the 25th, observations at 6.30 p.m. at Kensington showed the nova to be intermediate between Aldebaran and Capella, but by midnight the star had perceptibly dimmed. By the 28th of February, the star had dwindled to about 2nd magnitude. Observations made by Colonel Markwick and others also indicate that the greatest brightness, near magnitude —0.3, was reached about the 23rd of February.

Continued observations of the brightness of the star will be of great interest, and to those making estimates the following list of the magnitudes (Oxford Photometry) of the stars shown in Fig. 2 may be useful:—

Name.	Mag.	Name.	Mag.	Name.	Mag.
Capella ...	−0·08	τ Persei ...	4·07	λ Persei ...	4·39
α Persei ...	1·93	κ ,, ...	4·08	o ,, ...	4·40
β ,, ...	2·40	η ,, ...	4·13	ψ ,, ...	4·48
γ ,, ...	3·06	μ ,, ...	4·17	16 ,, ...	4·77
ζ ,, ...	3·09	ρ ,, ...	4·24	π ,, ...	4·89
δ ,, ...	3·11	θ ,, ...	4·26	ω ,, ...	4·94
ϵ ,, ...	3·13	48 ,, ...	4·30	30 ,, ...	5·55
ν ,, ...	4·06	ι ,, ...	4·39	43 ,, ...	5·66

The latest observation to which reference can be made in the present article was made on March 12, when the magnitude of the nova was estimated to be about 4.0.

The colour of the new star has also been changing. At the time of discovery, Dr. Anderson considered it to be bluish white, but a gradually increasing redness appears to have set in about the 25th of February, and by March 2nd the star was distinctly of a red tinge to the naked eye.

It is undoubtedly to the spectroscopic observations that we must look for the greatest additions to our knowledge of these strange outbursts, and it is satisfactory to know that excellent records of the spectrum have been secured. The earliest of these observations was made on February 22nd by Dr. Copeland, who found that the spectrum was then a continuous one crossed by a few dark lines, and described it as of a feebly developed solar type. At Harvard the spectrum was photographed on the 22nd, a few hours after Dr. Copeland's observations, and it was stated that the negatives showed 25 dark lines, six of them with bright lines on their less refrangible sides, and one with a bright line on the violet side.

In a communication to the Royal Society on February the twenty-eighth, Sir Norman Lockyer stated that 10 photographs had been obtained at Kensington on February 25th, and it was remarked that the spectrum of the latest nova was strikingly similar to that of Nova Aurigæ (1892). Brilliant lines of hydrogen at C and F, three strong bright lines in the green, and one in the yellow, each accompanied by a dark line on the violet side were obvious in a glance at the spectrum. The photographs showed similar pairs of dark and bright lines in other members of the hydrogen series, as well as in the K line of calcium, in addition to numerous other dark and bright bands. All the lines were very wide, and the separation of the bright and dark adjacent lines indicated a relative velocity of the two light sources of at least 700 miles per second, assuming that the displacement of the dark lines was due to motion in the line of sight. Some of the bright lines were apparently reversed—that is, there was a dark line down their centres. The velocities of the two light sources indicated by the spectrum were determined by photographing the spectrum of γ Orionis side by side with that of the nova; this disclosed the fact that the bright line source, apart from internal movements, was almost at rest with regard to the earth, while that giving dark lines was approaching the earth with the tremendous velocity already stated.

The spectrum is by no means easy to unravel, owing to the great breadth of the lines, both bright and dark. Spaces between bright lines may easily be mistaken for dark bands, and *vice versâ*. Nevertheless, starting with the supposition that as some of the lines are not unfamiliar, most of them may be met with in other stars, it seems possible that the true dark lines may be discriminated by a process of matching with stellar spectra. In this way Sir Norman Lockyer has concluded that the dark line spectrum of February 25th was very similar to that which the spectrum of α Cygni would assume if all its lines were to become greatly distended through violent internal motions or other causes. If this be a correct interpretation, the spectrum then consisted largely of the enhanced lines* of various metals, and a temperature considerably greater than that of the sun or Sirius was indicated at this stage in the history of the new star. The relation between the spectrum of Nova Aurigæ and that of the solar chromosphere to which attention was drawn by Vogel and others thus appears to have depended upon the presence of enhanced lines in each.

In another communication to the Royal Society on March the seventh, Sir Norman Lockyer gave an account of photographs taken on February 28, and March 1, 3, and 5, from which it appears that considerable changes in the spectrum were taking place. The continuous spectrum and bright lines other than those of hydrogen were rapidly fading; the bright hydrogen lines became very complex and were possibly quadruple; and some of the dark lines were dying out while new ones appeared. Careful examination of the photographs left little doubt that the principal bright lines in the green, near wave lengths 4924, 5018, and 5169, and a less bright one at 5317, were due to iron vapour at a very high temperature, while many others in the more refrangible parts of the spectrum also corresponded with high temperature metallic lines. Helium lines appeared to be absent, and the line in the yellow was probably D and not D^3.

During this period a great part of the light of the star was due to glowing hydrogen, and the star was, therefore, red for the same reason that many of the solar prominences are red.

Excellent photographs of the spectrum have also been obtained by Father Sidgreaves, Mr. Newall, and Dr. McClean; these exhibit the features described above, and Dr. McClean finds many coincidences between lines of the nova and those of Sirius, as would be expected, since the latter include numerous enhanced lines. M. Deslandres has also given a good account of the photographic spectrum (*Comptes Rendus*, March 4).

A further description of the photograph taken at Harvard on the 22nd of February, and details of others obtained on the 23rd, 24th, and 25th, have been received

* Enhanced lines are those which are brightened in the spark spectrum as compared with the arc spectrum, and since these lines occur without the arc lines in the spectra of some stars, which there is reason to believe to be at a very high temperature, they are regarded by Sir Norman Lockyer as indicative of high temperature when they are met with in other spectra.

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from Prof. Pickering (*Harvard Circular*, No. 56). It is extremely fortunate that the spectrum was photographed both before and at maximum brilliancy. At these stages in the history of the star, Prof. Pickering finds the spectrum to have been distinctly of the Orion type, with a few bright lines, chiefly on the red sides of dark ones. By the 24th, however, the spectrum had undergone a most extraordinary change, and then resembled the well-known spectrum of Nova Aurigæ, as it did on the 25th when photographed at Kensington. The full significance of this transformation is not yet clear, but it was evidently a most important event in the development of the new star.

The final stage, if Nova Persei behaves like Nova Cygni, Nova Aurigæ, and others, which it resembled soon after discovery, will be that of a planetary nebula.

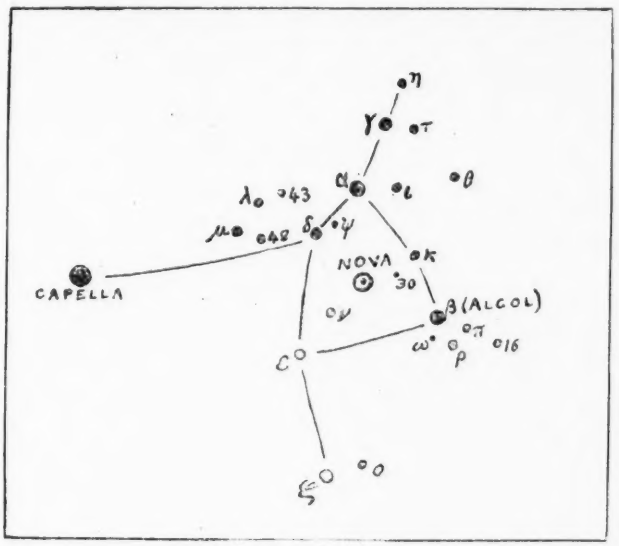

Fig. 2.—Perseus.

It may be worth while to add that up to March 3rd the principal features of the beautiful spectrum of Nova Persei were observable with a McClean spectroscope in use with a two or three inch telescope. This form of spectroscope is almost as easy to manipulate as an ordinary eyepiece, and is especially useful when it is not intended to take measurements of the lines.

Numerous theories have been advanced to account for such outbursts as that of Nova Persei, but judgment on them should perhaps be suspended until the present nova has been more completely studied. Still, a few remarks on this question may not be out of place. Attempts to explain a new star as the result of some action taking place in a single body have not been considered successful, chiefly on account of the difficulty of explaining the nebular state which most of them finally assume, and the collision theory in one form or another appears to be of much more general application. On Sir Norman Lockyer's hypothesis, the fact that a nebula remains is taken as an indication that a nebula —previously unrecorded—was there to begin with, and the outburst is attributed to the passage of a dense swarm of meteorites with great velocity through the sparser swarm composing the nebula; the denser swarm, on this view, is responsible for the dark line spectrum and the sparser one for the bright lines. Mr. Monck, in 1885, compared the action to that which takes place in a shooting star, and suggested that "new stars are dark (or faintly luminous) bodies which acquire a short-lived brilliancy by rushing through some of the gaseous masses which exist in space"; a somewhat similar view has been adopted and extended by Prof. Seeliger. Many of the phenomena seem to be explained on either of these suppositions, but collections of small bodies appear to be most consistent with the rapid cooling which takes place. In either case, the original nebula or "cosmic cloud" might be expected to shine more brightly after the collision than before, in consequence of the disturbance to which it has been subjected. The fact that gaseous nebulæ, like the new stars, occur in greatest abundance in the neighbourhood of the Milky Way strengthens the collision theory, and it may be noted, too, that on account of their greater dimensions nebulæ are much more likely than stars to be struck by wandering bodies.

It may be remarked that there is another possible explanation of the pairs of bright and dark lines which are found in the spectra of new stars, besides that which refers them to two bodies having a great relative velocity in the line of sight. The lines in certain spectra are displaced slightly when the vapours producing them are under pressure, and Prof. Wilsing has found that in spark discharges through liquids, pairs of lines somewhat resembling those of new stars appear in the spectrum. The evidence on this point, however, is incomplete.

As the great brightness of Nova Persei allowed of the application of powerful spectroscopes, it may be expected that a complete study of the spectra which have been observed and photographed will throw additional light on the origin of such celestial outbursts, and doubtless also on various other questions relating to the progress of events in stellar evolution.

It is satisfactory to know that the new star was seen independently by several observers, though Dr. Anderson appears to have been the first in point of time, and it was through him that the news was at once circulated. This, it will be remembered, is the second discovery of the kind with which Dr. Anderson's diligence has been rewarded, the previous one being that of Nova Aurigæ in 1892.

THE WHITE NILE—FROM KHARTOUM TO KAWA.

AN ORNITHOLOGIST'S EXPERIENCES IN THE SOUDAN.

By Harry F. Witherby, F.Z.S., M.B.O.U.

I.—THE DESERT RAILWAY, KHARTOUM, AND OMDURMAN.

Shortly after the battle of Om Debreikat and the death of the Khalifa Abdullahi, I found that it would be possible to travel in the Soudan. For fifteen years the country had been in the hands of powerful savage tribes, and before that time English naturalists, and especially ornithologists, had greatly neglected the Soudan, although some Germans, as for instance Brehm, Heuglin, and von Müller, had done excellent work there. The country being thus more or less new ground to English ornithologists, I was the more anxious to visit it, and study the birds of a small portion at all events of what had become English territory, at least by right of conquest.

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So on the last day of February, 1900, I set out from England, joining at Marseilles Messrs. E. H. Saunders and C. F. Camburn, two taxidermists who were to accompany me, and we reached Cairo on March 6th.

The journey from Cairo to Wady Halfa, even under the new conditions created by the railway, is to-day so well known that it requires but a brief description.

Instead of a long journey by boat up the Nile one can now travel from Cairo to Assouan in about 22 hours in a train, which for ease and luxury would not shame any European railway. Notwithstanding the lowness of the Nile at the time of our visit, the country from Cairo to Luxor was green and luxuriant. Camels, cattle, sheep and goats abounded, and everywhere the half-naked people of many shades of chocolate, brown, and black were working on the land. Beyond Luxor the area of cultivated land grew gradually less. Wells, sakiehs, and shadoofs were not so frequent, villages were passed at longer intervals, and the inhabitants and their cattle became more rare in the landscape.

At Assouan we found every comfort. From this point to Omdurman we travelled under the joint Government of the Queen and Khedive. From Assouan a short piece of line took us to Shellal, above the first cataract, and there just opposite the Temple of Philæ we embarked upon a steamer, for no railway yet connects Assouan and Wady Halfa. And here the character of the country completely altered. The day before we had travelled through a flat fertile land, whilst now we were steaming up the great river through a wild and desolate country of bare rocky hills, and having the merest strip of cultivated land by the edge of the river.

Here and there, however, where flat ground was available between the river bank and the foot of the hills, as for instance at Korosko, cultivation was carried on. But this was only possible with the aid of an elaborate, although primitive, system of irrigation. The sakieh, an endless chain of pitchers, somewhat in the form of a water-wheel, turned by oxen, and the shadoof, a bucket at the end of a long lever balanced by a lump of mud and worked by men, were employed in raising the water from the river above the high bank. Often two sakiehs, or four or five shadoofs one above another, or a combination of sakiehs and shadoofs, were necessary to lift the water, so low was the river and so high was the bank.

Of birds there were few in this reach of the river, but we noticed particularly that the hooded or grey crows* so common north of Assouan, were no longer to be seen, their place being taken by a crow of pure black and white,† which was to be found as far south as we afterwards travelled.

The scenery was bold and impressive, and the colouring exceedingly beautiful. The blue-grey river, edged with a strip of bright green crops, and here and there a patch of dazzling white sand, led one's eye away above the bank where the desert seemed to have overflowed, and poured forth between the rocks great streams of sand of a deep rich orange colour. A background of pinkish hills, and the pure blue sky above, completed a scheme of colouring difficult to surpass. One night by the light of a brilliant moon all these colours were to be clearly distinguished, even to the pink of the distant rocks and the blue of the sky, but of such delicacy was the colouring that the whole scene became etherealised.

Our progress by the river was slow and laboured. Owing to the shallowness of the water, it being the midst of one of the driest of dry seasons, the steamer grounded and stuck continually, notwithstanding its flat bottom and shallow draught. By dint of much twisting and turning and a vast amount of hard labour on the part of our crew in poling and hauling, as well as in lightening the boat, we were not called upon to wait until the Nile rose before reaching our destination. Judging by their constant and hearty calls for aid from above, one could well believe that the crew ascribed this good fortune to the will of Allah and his Prophet rather than to their own exertions.

So we passed rocky Korosko, Ibrim perched on the top of a high and precipitous cliff, the wonderful rock temple Abu Simbel, and in four days from Assouan arrived at Wady Halfa.

Once a miserable village, Halfa now boasts of great workshops fitted with all the necessary machinery and appliances to keep in repair, and even to manufacture,

A Sakieh.

everything connected with a railway, and the new town has been appropriately termed a miniature Crewe. From Halfa the wonderful railway which bridges 230 miles of waterless desert originated, and from Halfa to an ever increasing distance each day, with marvellous regularity during its construction, ran two trains with construction materials, and water and food for the great army of workers at railhead. In eleven months from its commencement all difficulties, and there were many, were overcome, and a railway which the best authorities had dubbed as the idea of a lunatic was completed. The journey from Halfa to Abu Hamed formerly occupied some ten days. It is now possible by this "short cut" across the desert to accomplish it in about as many hours. Of course this railway, both as regards permanent way and rolling stock, has vastly improved since the days of the expedition which culminated in the battle of Kerreri and the capture of Omdurman, and it has been extended from the Atbara, its former southern terminus, to the banks of the Blue Nile opposite Khartoum.

We travelled up in the last so-called tourist train of the season. This train was put together at Halfa, and many of its fittings were made there. It was somewhat devoid of cushions and elaborate fittings, which

* *Corvus cornix*, Linn. † *Corvus scapulatus*, Daud.

was only right in so dusty a country. But as far as comfort went one could wish for nothing better. Every necessity was on the train, cars for sleeping in, cars for dining in, cars for smoking in, an excellent *cuisine*, and even bath rooms. We stopped for every meal on account of the jolting of the train. At first the dust was rather a trial, but the quantity of it depends much upon the position in the train which one occupies, and also upon the direction of the wind. And after all one soon gets accustomed to eating, drinking, and wearing dust. On our journey up we accomplished the distance of 576 miles from Halfa to Halfaya on the Blue Nile, including all stoppages, in 34 hours. But on the journey down in an ordinary train, which did not stop for meals, we did the distance in 29 hours. During part of this time we ran at the rate of 40 miles an hour with an excellent American engine, one of two engines which had to be obtained from America, because at the time they were urgently required, British engineers were fully employed in a strike and could not attend to such business as building railway engines. From Halfa to Abu Hamed the railway runs across a bare desert far from the river, which here takes a great sweep. Sand, flat and monotonous, as far as the eye can reach, stretches out on every side. Here and there a stunted mimosa bush or a black rock rising conspicuously from the sand serves but to accentuate the loneliness and barrenness of the scene, while the mirage on every side tantalizes the eye with its shining dazzling mockery. At intervals along the single narrow track are "stations," so called, but otherwise they are nameless being only numbered one to nine. Each of these boasts of one or two tents, and some tanks of water. At some are stores of coal, and at two there are pumps, which bring up from deep below the sand that priceless water which, with "Kitchener's luck," was happed upon during the construction of the railway, when water was so valuable for men and engines that a whole month was gained by these finds. At several of these stations we saw ravens,‡ and at one, kites.§ What induces these birds to live in such forsaken spots, and upon what they feed, unless

The River Bank, Omdurman.

it is on just the scraps they can pick up round the tents, and how they get water to drink, are puzzles difficult to solve.

At Abu Hamed, with its small white-washed station house, the river was reached again, and here a few scraggy dôm palms, the hard round fruit of which is nicknamed Dervish bread, are a delight to the weary eye. From this point onwards the country is less uninteresting. Mimosa scrub and stunted acacia trees struggle for an existence in the gritty sand, dark rocky hills rise in the distance, and a group of gazelles or a flock of small birds may now and again be seen.

We passed many a place made famous by conflict—Berber, the Atbara with its fine bridge, Shendy opposite Metemma—and at length arrived at the railway's unpretending southern terminus, Halfaya, a collection of a few huts upon the sand on the north side of the Blue Nile almost opposite Khartoum. Here we were greeted by a dust storm, which is no unusual thing at Halfaya, a fact which has given the place a nickname of much the same sound but of a deeper significance. After considerable delay we embarked on a steamer—a dahabeah—which was to take us over to Omdurman, and upon which we were to live during our brief sojourn there.

The "Bazaar" at Khartoum.

Steaming down the Blue Nile towards Omdurman we had a good view of Khartoum, which is built along the southern bank of the river amidst a grove of palm trees. It will be remembered that Khartoum was deserted, and converted into little less than a heap of ruins by the Mahdi, who set up his capital at Omdurman, a mere village at the time of the fall of Khartoum.

We are now reverting to the old order of things, and although at present nearly all the business both official and private is transacted at Omdurman, yet Khartoum will soon become again the chief town and centre of the Soudan. At the time of our visit few buildings in Khartoum were completed, but along the bank of the river houses and government offices were springing up, to say nothing of a fair-sized hotel. But the buildings to which most interest attaches are the Sirdar's palace and the Gordon Memorial College. The palace, which had been completed and occupied for some time, is a large and imposing though somewhat bald and ugly structure. It is built on the spot formerly occupied by Gordon's palace, and portions of the old foundations and walls have been utilized. At a little distance from the Palace a mass of scaffolding and stone showed where the Gordon Memorial College was growing into existence.

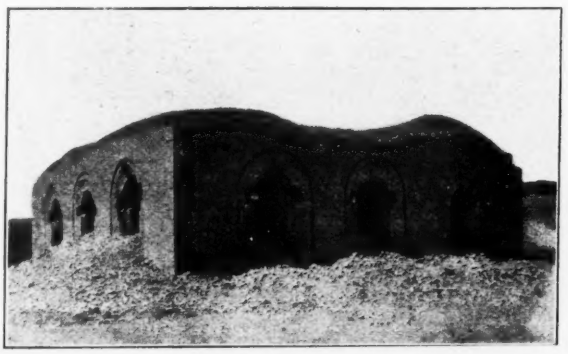
As we neared Omdurman the shadow of a cloud seemed to be hanging over part of the river, the edge of the shadow being clearly defined in an uneven line even at some distance. But a glance upwards showed no cloud. The ragged line which seemed to mark where the shadow

‡ *Corvus umbrinus*, Sundev. § *Milvus aegyptius*, Gm.

ended and the sunlight began was in reality the point at which the Blue Nile, with its clear dark blue waters, joined with the White Nile, the waters of which are heavily charged with sand and have a whitish appearance. As we passed over the line of junction, the idea of the shadow still prevailed, and so definitely was the thick grey water separated from the clear dark water that no mixing appeared to be taking place. We steamed across the united rivers, which form the Nile of Egypt, and tied up to the bank at Omdurman alongside three of the gunboats which had played so important a part in the "river war." Near by stood the works where many an old steamer, which most engineers would have broken up for scrap iron—one at all events dating from Gordon's days—has been miraculously patched up and made to work again.

There was much to be done at Omdurman, and the dust and heat as well as the extent of the place by no means facilitated matters. The town is a most bewildering place. It is built on a fairly flat piece of bare desert about six miles long by an average of two miles wide. This piece of desert is a mass of low mud houses surrounded by compounds and separated by high walls. A few broad straight roads, which are mere sand, and innumerable narrow winding alleys, intersect the collection of huts and compounds, while here and there is a yawning pit, or an acre or so of broken-down houses, such as those in the Baggara quarter, which is now but a heap of mud. Although the place itself has a peculiar fascination, perhaps on account of its history and the many unlooked-for secrets these numerous walls may even now be hiding, there is not much of interest to see in Omdurman. The houses are mostly built on the same plan—four mud walls with a flat roof made of rafters covered with straw or matting, a verandah in front, and sand for the floor. The few which have two stories were formerly occupied by the Khalifa and his chiefs. The Khalifa's own house stands at the corner of an immense square some 600 yards long. Outside the house in the square one can see the remains of what was once a brick platform, from which the Khalifa used to preach to his thousands of fanatical followers packed in the great square. There on the last day of August, 1898, he held his last review, inciting the assembled hosts in a vigorous harangue to fall upon the invading army of British and Egyptians, to drive them into the river and annihilate them, and there the dense mass of misguided savages clad in their patched jibbehs shook their spears and became mad for the blood of the accursed infidels.

In 1900 in the same square a few orderly squads of Soudanese, dressed in neat khaki uniforms, might be seen industriously drilling to words of command given by a sergeant as black as themselves, with neither an Englishman nor an Egyptian present. Yet most of these Soudanese were the same men who had thirsted for and spilt our blood such a short time before. That they were no less eager to fight one could tell by the fierce energy of their drill, but above them, near their former master's house, floated two flags side by side—the Union Jack and the Crescent and Star, and around them, working in the houses so lately occupied by their ignorant and brutal chiefs, were a few British officers in their shirt sleeves administering the Soudan. Just outside the great square is a small enclosure surrounded by high walls, and in this may be seen a great heap of bricks with a square of arches round it—all that is left of the Mahdi's tomb, for ten years the most sacred and revered object in the Soudan. Leading out of this enclosure is a compound with a small mud house, the English Officers' Club, and here every evening the Soudanese may catch a glimpse of the members playing tennis or racquets. One of the most interesting places in Omdurman, although now in



The Ruins of the Mahdi's Tomb.

ruins and difficult to find, is the "Saier," the awful prison in which Charles Neufeld and so many other victims of the Khalifa spent years in torture. Slatin Pasha writes thus of the horrors of this place:—"A gate, strongly guarded day and night by armed blacks, gives access to an inner court, in which several mud and stone huts have been erected. During the day-time, the unhappy prisoners, most of them heavily chained and manacled, lie about in the shade of the buildings. . . . . At night the wretched creatures are driven like sheep into the stone huts, which are not provided with windows. . . . . It is a painful sight to see scores of half-suffocated individuals pouring out of these dens, bathed in perspiration, and utterly exhausted by the turmoil of the long and sleepless night."

The walls round this awful place are now broken and crumbling, and only portions of the huts remain. But enough can be seen to make it almost impossible of belief that any of the crowd who were forced into these dens could have lived through one night. That many succumbed we know. Outside the huts in the small compound could be seen the remains of three or four brick platforms on which the most favoured prisoners were allowed to rest at night.

To turn to pleasanter things. Of the birds of Omdurman itself there is little to say. There is not a tree near the town, nor is there any vegetation. Consequently there is little else but carrion on which a bird could feed. Kites and Egyptian vultures,‖ both excellent scavengers, are the most conspicuous birds. And all over the town are homely house sparrows,¶ a little smaller and more brightly coloured than our familiar birds, but every whit as cheeky and pushful. Down by the river one may often see a striking black and white kingfisher,** hovering over the shallow water, and every now and again dropping down to the surface like a stone. If you watch carefully you will notice that this graceful action is repeated many times before the bird makes a successful plunge and rises with a fish.

Across the river, on a sandbank, a few pelicans,†† some

‖ *Neophron percnopterus*, Linn. ¶ *Passer rufidorsalis*, Brehm.
** *Ceryle rudis*, Linn. †† *Pelicanus onocrotalus*, Linn.

graceful egrets and herons,‡‡ and other wading birds may be distinguished.

When once we got into the swing of things and began to learn our way through some of the mazes of the town, preparations for our journey up the White Nile did not take long. Time being precious I determined to spend as little as possible in travelling, but to work thoroughly a small tract of country from Omdurman south along the White Nile. With this in view we decided to travel entirely by land, as being a more thorough method of exploring the country, although much slower and more fatiguing than travelling by boat. Our task in Omdurman was to obtain permits and servants, and animals to carry our baggage and ourselves. At first we tried to buy camels, and several Arab sheikhs were induced to make a parade of their beasts before us. Feeling sure, however, that such camels as were shown us would become the prey of dogs and vultures after a day's march, we waived their owners politely away. At this deadlock I learnt most opportunely that His Excellency the Sirdar, Sir Reginald Wingate, through the agency of Bimbashi F. G. Newall, of the Intelligence Department at Omdurman, had most kindly already hired baggage camels for me from the sheikh who contracts to supply the Government. This difficulty being thus pleasantly overcome we turned our attention to procuring our own mounts. Good horses and saddles were difficult to obtain, and to feed horses in such a dry season would have been a difficult matter. Riding-camels were expensive, and a doubtful luxury. We, therefore, fell back upon donkeys. But the donkey of the Soudan is a miserable little beast compared to that of Egypt, and although our animals, bought after a wearisome amount of bargaining and trials, carried us fairly successfully, we often wished for better mounts. We made a great mistake in using the wide wooden native saddles, which even with the aid of pads and a sheepskin became exceedingly uncomfortable at the end of a long day's march. Quite the mount for our journey would have been a bicycle. The desert tracks, at all events as far south as we travelled, are quite hard and smooth enough to make bicycling possible and often enjoyable.

A permit to travel as far south as we cared to go on the east bank of the White Nile was granted us, but we were prohibited on account of the unsettled state of the country from journeying on the west bank at all. This somewhat altered my plans as I had hoped to be able to make several excursions into Kordofan from the west bank.

Licenses to carry arms and to shoot were also necessary. By licensing each gun, rifle, or revolver, instead of the user, the authorities make a distinct gain for the Revenue. Some very fair game laws have also been drawn up for the Soudan. No one is allowed to kill the zebra or the ostrich. A special license authorises the holder to kill a very limited number of adult male buffalo, elephant, giraffe, hippopotamus, and rhinoceros, and for each animal killed, a special fee has to be paid. A less expensive license allows one to kill antelope, gazelle, and warthog. All other animals and birds may be shot by the holder of an ordinary gun license. These regulations might well be revised and made still more useful, and no doubt Capt. Stanley S. Flower, who has lately been appointed Director of the Soudan Wild Animal Department, will see to it that better protection is afforded to many scarce animals, such as giraffes and some of the rarer antelopes.

‡‡ *Herodias ralloides*, Scop; *Herodias garzetta*, Linn.; *Ardea purpurea*, Linn.

FLOWERING PLANTS,

WITH ILLUSTRATIONS FROM BRITISH WILD-FLOWERS.

By R. Lloyd Praeger, B.A.

II.—CONCERNING LEAVES.

The stems of plants, as stated in my last article, are the framework on which the leaves and flowers are spread out to catch the light and air, and we find definite relations existing between the form, position, and strength of stems, and the shape, weight and function of the organs which the stems support. The branches of an Apple or Pear tree have to be sufficiently strong not only to withstand the stress of winter gales, and the burden of the wealth of blossom and foliage of early summer, but also the weight of the abundant fruit of autumn. It is interesting to note that among our cultivated fruits, strength of stem has not kept pace with the increase in weight of fruit due to artificial selection, so that in gardens our artificial fruits must needs, in a season of abundance, be supported by artificial stems —by props and crutches, lest, like the legs of the prize turkey in the "Christmas Carol," the branches might snap like sticks of sealing-wax. In evergreen trees, the weight of snow is a serious contingency that must not be neglected. Nor must the chance of accident owing to wandering animals be left out of account. The young Ash saplings, a few feet in height, are as pliable as willow-wands, and spring back into their places as we force our way through them; but the knobly twigs of an old Ash tree, which swing clear in the air high overhead, are brittle, and snap across if we attempt to bend them; the elasticity of the whole bough is sufficient to bring them safely through the heaviest storm.

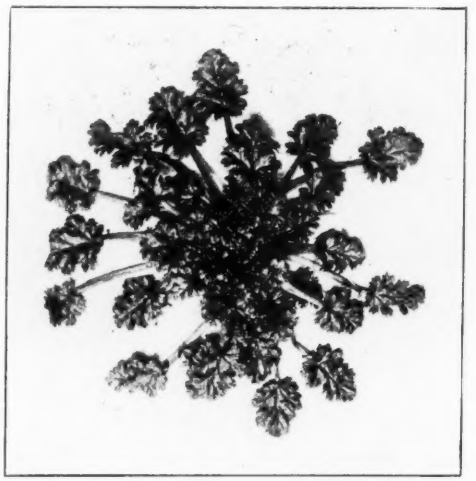
Between the form of a twig and that of the leaves which it bears we can generally at once perceive a relation. The little leaves of the Birch are borne on twigs slender as a piece of twine. The Oak and Elm, with larger leaves, require a stouter twig for their support. The Sycamore and Ash have twigs which are stouter still. The large leaves of the Horse Chestnut are borne on very thick twigs, in which the principle of the hollow column is introduced.

The arrangement of the leaves on the stem, or *phyllotaxis*, is a question of the first importance. The leaves must be so grouped that all may receive as much light as possible. So far as can be arranged, there should be no overlapping, nor should any of the available space be wasted. On the stem of the Ash, or Sycamore, or Teazel, the large leaves are arranged in alternate pairs, the direction of the axis of each pair being at right angles to that of the next. Thus two spaces or *internodes* separate any pair of leaves from the nearest pair which, being placed in the same position, might overshadow it. This is a very simple case, which we shall find to be the rule when we examine plants in which the leaves are borne in opposite pairs. When leaves are borne in whorls of three a similar rule will be found to hold good. The position of the leaves of any whorl is such that they are vertically below or above the *spaces* between the leaves of the next whorl. It will be seen at once that the amount of light received by each leaf is materially increased by this arrangement. If in a theatre we can look between the heads of two people in the row immediately in front of us, the head of a person in the next row beyond, even though directly before us, does not much interfere with our view of the stage. In most cases, however, the arrangement of the leaves on the stem is much more complicated than

this. The leaves usually emerge singly. If we join by a line the point of emergence of a leaf with that of the next leaf above it on a stem, and that again with the next, a spiral will be the result, along which at equal intervals we reach the *nodes*, or points where leaves are borne. And the distance between these nodes will be always found to bear some definite relation to the total length of the spiral line in making one complete revolution round the stem. If the distance from node to node is one-half of this whole distance, it signifies that the leaves are borne alternately on opposite sides of the stem, each leaf being vertically below the second one higher up the stem—a very common arrangement. Or the leaves may be borne three to each spiral revolution, so that the position of each leaf shifts one-third way round the stem as compared with the preceding leaf. If we look along such a stem, the leaves will appear to be borne in three vertical rows, with an equal angle between each. Examining some other plant, we may find that we have to go as far as the fifth leaf before we find one vertically above the one from which we started, and if we measure the horizontal distance from any leaf to the next above or below it, it will be found to equal two-fifths of the total circumference, so that we have to go five times two-fifths way round the stem, or two complete revolutions, before completing the cycle. This is called a two-fifths phyllotaxis. In many other cases, the arrangement is immensely more complicated, and need not be entered on here. What is important for us to note at present is that by means of this orderly mathematical arrangement, the leaves are so distributed that each fulfils its functions to the best advantage.

The shape of leaves offers an almost inexhaustible field for observation and scientific speculation. Mr. Ruskin has said:—"The leaves of the herbage at our feet take all kinds of strange shapes, as if to invite us to examine them. Star-shaped, heart-shaped, spear-shaped, arrow-shaped, fretted, fringed, cleft, furrowed, serrated, sinuated, in whorls, in tufts, in spires, in wreaths, endlessly expressive, deceptive, fantastic, never the same from footstalk to blossom, they seem perpetually to tempt our watchfulness and take delight in outstripping our wonder." The size of leaves will naturally vary inversely as their number. A plant of a certain size—say a tree—will require a certain total area of leaf for the manufacture of the requisite amount of plant-food. If we cut the branch of a Horse Chestnut and of a Beech where each had exactly a diameter of one inch, or two, or six inches, and counted and measured the leaves on each, while the number of Beech leaves would immensely exceed the number of Chestnut leaves the total leaf-area would be about the same in each case. This area of green leaf, then, must be spread out to the best advantage. In this connection, a beautiful relation between the shape of leaves and their arrangement on the stem may frequently be remarked. Lay a twig of Beech on a sheet of white paper, and note how small are the interstices between the leaves through which the paper may be seen. The shape of the leaves, and the intervals at which they are borne, are so related that an almost continuous expanse of green is offered to the sunlight. A more remarkable case may be seen in the Lime, whose leaves are quite inequilateral, being contracted on one side at the base and expanded at the other, in order the more exactly to fill the space which is available. The Elm likewise furnishes a beautiful example of close-fitting leaves. In most trees in which, like the Beech, Hazel, and Elm, the leaves lie in close-ranked rows in the same plane as the twig which supports them, we find more or less oval leaves, their breadth varying with the space between the leaves, *i.e.*, the length of the internode. In trees such as the Horse Chestnut or Sycamore, on the other hand, the leaves grow in opposite pairs, and are typically arranged on upright twigs, the leaf-stems projecting at a wide angle from the twig, with the surface of the leaf horizontal. In this case space is not so curtailed; the leaf is larger, and more or less circular in outline; and the great increase of length in the internodes, as compared with the trees lately considered, prevents a too great overshadowing of the lower leaves by those higher up the shoot.

In plants which have a very short axis—which have in popular language "no stem"—a difficulty arises as to how all the leaves shall receive a due amount of light, since all arise from the same point. This is met in several ways. The leaves are often placed at different angles, the outer leaves, which are the lowest and oldest, spreading horizontally near the ground, the newest rising almost vertically in the centre, the intermediate being disposed at various angles between these extremes. Another solution of the difficulty is effected by a continued growth of the leaf-stalks, each leaf steadily pushing itself outward so that the whole form a slowly expanding circle, in which each leaf-blade successively occupies a position commencing at the centre, ending at the circumference. Such leaf-blades, it is almost needless to say, are widest at the extremity, since that is the portion which receives most light; often the blade is roundish, and placed at the end of a bare leaf-stalk, which pushes it further and further from the centre, as other leaves arise. Such arrangements are well seen in many of our biennial plants. During their first season they form a close leaf-rosette of this kind, which manufactures during the summer and winter a supply of plant food to be stored for the building up of the



Winter leaf-rosette of the Sea Stork's-bill.
From a photograph by Mr. H. J. Seymour.

tall flowering stem of the succeeding year. The Stork's-bills (*see* figures), Crane's-bills, Teazel, and other plants will occur to the reader as examples.

In the case of a few British plants, the normal position of the blade of the leaf is not horizontal, but vertical. The Black Poplar and its relation the Aspen furnish well-known instances. If we examine the stalk of an

Aspen leaf we notice that while the lower part of it is circular in section, the part near the leaf is much flattened, permitting free movement in the plane of the leaf-blade. This, together with the position in which the leaves are borne on the twigs, causes the leaves to hang vertically. One result is that the light can stream almost unbroken through the branches even to the ground below, the wealth of foliage producing but a faint tremulous shadow as the leaves rustle in response to every breath of air. Well does Scott, seeking for a simile, say in *Marmion*:—

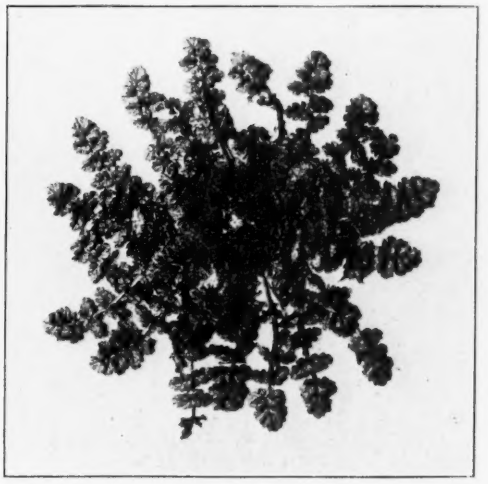
"Variable as the shade
By the light quivering aspen made."

A peculiar point about these vertical leaves should be noted. In discussing the question of plant-food in Knowledge last year, Mr. Pearson explained the important functions fulfilled by the leaves; how on the under side of leaves are situated a myriad of tiny openings (*stomata*, mouths) through which the plant absorbs carbon dioxide from the atmosphere, and having taken from it the carbon, liberates the oxygen, the stomata being also used for the escape of the surplus water of the plant. Now, the reason why these mouths are situated in most plants on the under side of the leaves is no doubt because they are thus protected from cold and rain and storm, and their work less interfered with. In the Aspen, with its vertical leaves, either side of which is equally exposed to atmospheric vagaries, there is nothing to choose between the two sides as regards the position of the stomata, and as a matter of fact, these are equally distributed over both sides of the leaf. A further modification of this kind we may find in plants like the Water-lily, the leaves of which float on the surface of water. Following out our line of argument, we would expect to find the stomata confined to the *upper* side of such a leaf, so that they may be in contact with the atmosphere, and this is exactly what we do find. Plants whose leaves are all continually below the surface of the water, such as the Water Lobelia and many Pondweeds, must perforce be content with obtaining the carbon dioxide which they require from the small quantity of that gas which is to be found dissolved in the water.

The protection of leaves against various hurtful agencies next claims our attention. The typical leaf has its upper surface built of strong closely-placed cells, to offer a stout resistance to rain and hail, and to frost or overpowering sun-heat. In hot dry weather, when great evaporation is taking place, the plant can close up all its stomata—shut down, so to speak, all the sluices by which the water employed to convey dissolved salts from root to leaf is allowed to escape, and thus retain an abundant water-supply in spite of parching heat. But in arid ground, such as sandy wastes or sea-beaches, further protection against over-transpiration may be desirable, and this is frequently effected by impervious varnish-like layers on the upper surface of the leaves, or by dense coverings of hairs. Layers of impermeable corky cells in the epidermis or skin of the leaves are also frequently to be found in plants liable to excessive transpiration. Such impermeable leaves are beautifully developed in plants like the Stonecrops, which, growing in dry ground and on rocks, and being liable to long-continued drought, store up in their leaves a copious water-supply. Such reservoir-leaves are greatly developed in the plants of desert countries. Protection against the often fatal effect of frost is likewise afforded by a thickening of the cuticle of leaves, and especially by felt-like coverings of hairs. In some noteworthy cases protection against cold is effected by means of movement on the part of the leaves. The most familiar examples occurring among our native plants are furnished by the trifoliate leaves of many of the Clover family. As evening approaches, the Clovers and their allies fold their three leaflets together by means of an upward movement; the juxtaposition of the leaflets retards loss of heat, and the vertical position which they thus assume has the same effect, tending to check the radiation of heat to the cold sky overhead. The Wood Sorrel, which, though of a quite different order, has leaves which resemble those of the Clovers, effects the same object by folding its leaflets *downwards*.

Wet, which by lying on the leaves might hinder transpiration, must also be guarded against; a danger which in many species is obviated by means of a waxy excretion, especially on those parts of the leaves where the stomata are situated; on which, as on an oily surface, water will not lie.

Another danger to which plants are exposed, and one which we might think they would be powerless to meet, is the attacks of browsing animals—animals of all sizes, from minute insects up to great munching cattle. But to note how perfectly such defence may be provided for we need only look at our common Gorse, which boldly invades the pasture, protected by its impenetrable chevaux-de-frise. This plant, indeed, seems to have put so much of its vital energy into the production of spines, that it has none left with which to produce leaves, and, as already remarked, the making of plant-food has to be carried on by the green and much-branched stems. The beautiful tribe of the Thistles naturally comes to



Winter leaf-rosette of the Hemlock Stork's-bill.
From a photograph by Mr. H. J. Seymour

our minds in this connection. Armed with innumerable spines of the most exquisite structure, sharper and more delicate far than needles, the Spear Thistle and Marsh Thistle raise their tall and graceful forms untouched amid the close-browsed herbage, and without fear of molestation—save from man, with his implements of iron—open their flower-heads to the sun and the insects, and scatter their numberless winged fruits to the wind. In the Thistle the spines are borne alike on the stems, leaves, and involucres or outer whorls of the heads of flowers. The Holly is an interesting case. In low bushes the edges of the leaves are provided with strong

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spines; but when the bush grows into a tree, and bears leaves far above the reach of browsing animals, the unnecessary spines disappear, and the edges of the leaves are entire. In the Blackthorn and Hawthorn, the strong spines are modified branches; and we may observe that they are much more numerous in young plants than in old bushes. A more complicated mode of protection is found in the Nettles. They are furnished with hollow hairs, filled with a virulent fluid, and bent at the tip. A slight pressure causes the curved extremity to break across, leaving a slender tube, tapering to an extremely fine point, which easily enters the flesh and discharges a portion of its venemous contents.

So far we have considered leaves as fulfilling their normal functions of producing plant food by means of chlorophyll cells. In conclusion, brief reference may be made to various exceptions; for the production of plant-food is not necessarily carried on by leaves, nor is the use of leaves altogether limited to the production of plant food. First, leaves may be dispensed with, as we have already seen in the case of the Gorse. The stem may be modified to supply the place of leaves, as in the Butcher's Broom, whose flattened "leaves" are really branches, as we see when we find flowers and fruit borne on these flat leaf-like structures. In climbing plants the leaves, or a portion of them, are frequently converted into tendrils, often endowed with a marvellous sense of touch, for grasping supports and thus aiding the plant in its upward climb through surrounding herbage to the light. This is seen in many of the Vetches, the upper end of whose leaves are modified in this fashion. In the Yellow Vetchling (*Lathyrus aphaca*) a further modification has taken place. The whole leaf is converted into a tendril, while the stipules (the usually small pair of leaf-like appendages that often grow at the point where a leaf joins a stem) are enlarged into a very respectable pair of "leaves," and manufacture food while the true leaf helps the plant to climb. Of other much stranger modifications of leaves Mr. Pearson has written in Knowledge last year, Vol. XXIII., pp. 245-6—of the marvellous tentacles which the leaves of the Sundew bear, which catch and digest insects; and how certain leaves of the Bladderwort are converted into snares on the most approved rat-trap plan, for the same purpose—some of the most marvellous fairy-tales of botany.

NOTES

Astronomical.—The recent observations of Eros have resulted in the remarkable discovery that the planet is probably accompanied by a satellite nearly as large as itself. The first indication of this fact was the detection, by Dr. Oppolzer, of variability to the extent of about a magnitude in the luminosity of the planet in the period of a few hours. Confirmation of the variability has been obtained by two French astronomers. M. F. Rossard found the magnitude to range between 9·3 and 11·0 on February 14th, 15th, and 16th, and concluded that the period was 2h. 22m. M. Ch. André believes that his observations indicate a period of about six hours, and states that the light-changes are similar in character to those of the well-known variable U Pegasi; the system being probably composed of two asteroids, with diameters in the proportion of three to two, the plane of revolution passing through the earth. As the inclination of the plane of revolution to the line joining Eros and the earth changes, corresponding differences in the variability may be expected.

There is every indication that adequate records of the total eclipse of the sun on May 18th will be obtained, if the weather should fortunately be favourable. Mr. and Mrs. Maunder will be stationed in Mauritius, where they will work in conjunction with Mr. Claxton, the Director of the Royal Alfred Observatory. In Sumatra, where the duration of totality on the central line is over six minutes, there will be quite an army of astronomers, including Mr. Dyson, of Greenwich; Mr. Newall, of Cambridge; parties from the Lick, Yerkes, and Washington Observatories, and a Dutch expedition under the direction of Dr. Nijland. Photographs of the corona on a large scale, to show the details near the sun's limb, and on a smaller scale to depict the streamers, will be attempted, in addition to spectrum photographs with slit spectroscopes and prismatic cameras.

An extensive comparison of sun-spot and magnetic data which has been made by Father Sidgreaves, supports the view that the distinct connection disclosed cannot be due to a direct action of the sun upon the earth, but rather that there is a common cause for both. Large sun-spots are frequently unaccompanied by magnetic storms, and the cause therefore does not always affect both the sun and the earth at the same time.

The discovery of sixty-four new variable stars is announced in Harvard College Observatory Circular No. 54, a large proportion of them having been found from the presence of bright hydrogen lines in their spectra. Many stars whose spectra are of the fourth type also prove to be variable. These variables have been divided into two classes. First, those in which the variation is so great that it is obvious to the most inexperienced observer. Secondly, those in which the variation so far detected is small, about half a magnitude to a magnitude. In each of these cases, two or more experienced observers, who are accustomed to accurate measures of photographic brightness, are satisfied that the change is real.—A. F.

Botanical.—Under the heading "Economy in Nature," in *Torreya*, a new publication of the Torrey Botanical Club, Mr. P. A. Rydberg mentions a cherry tree which, till quite recently, grew in New Orange, New Jersey. It had an unusually thick trunk, which divided at about seven feet from the ground into two trunks. At the junction of these was a large hole, showing that the stem was decayed and hollow. A strong wind tore away one of the trunks, when it was found that the hollow stem was partly filled with refuse, consisting of decayed cherries and leaves. Into this a stout root, originating from the margin of the hole, had grown, and had then sent off numerous branches into the decaying stem of the tree, which was thus actually preying upon itself.

Brachystelma Bingeri, a new Asclepiad with an edible tuber, is described and figured by M. A. Chevalier in the *Revue des Cultures Coloniales* for February 5th. It is a native of the region of the Upper Niger. The tuber resembles in taste the Jerusalem artichoke, and though only slightly nutritive, its value as a food is augmented owing to the fact that it can be procured when supplies of rice and millet are exhausted. Other species of

Brachystelma, and a *Ceropegia*, are cited, all of which possess edible tubers.

The *Comptes Rendus* for February 11th contains an interesting paper by M. Bernard, entitled "Sur la tuberculisation de la Pomme de terre," in which it is shown that the potato-tuber is produced by the action of a fungus, *Fusarium Solani*. This fungus is always present in the tubers, whether healthy or diseased, and attacks the growing subterranean stems, inducing, it is supposed, the arrest of their growth and the development of the tubers. —S. A. S.

CYCLONES.—At the meeting of the Royal Society of Edinburgh on March 4th, Mr. John Aitken, F.R.S., contributed some additional notes to his paper on "Dynamics of Cyclones and Anticyclones," read a year ago. He was of opinion that cyclones are found over those parts of the earth where there is a high temperature. The movement of the storms in our own area is in a north-easterly direction, because the winds on the north-west side of the anticyclones were generally stronger than those on the other sides. The cyclone is formed out of air from the south travelling towards the north and rotating at a greater rate of velocity than the surface of the earth. He asked: "What is a cyclone?" and answered his question by saying that it is caused by hot air ascending and drawing in air all around it, that it is formed by the anticyclone, and that it is on the north-west side of the anticyclone that we get the strongest winds. The general theory is that a cyclone is not an independent power at all, but is simply a large eddy produced by the action of two anticyclones. Cyclones may be divided into convectional and dynamical, and the distinction may be explained in this way. If the cyclone is convectionally driven, the currents move towards the centre, but if dynamically driven they will move spirally outwards. The exhaustive investigations made at Washington show that the general tendency is inwards, and, further, that in convectionally-driven cyclones the velocity increases towards the centre, but when dynamically driven the velocity does not increase. Mr. Aitken also spoke of the great storm tracks from America, the one passing to the north of the British Isles, and the other to the south; and of how at certain seasons the one moved southwards and the other northwards, and so decreasing the intervening space and *vice versâ*. However powerful an anticyclone might be, a vast amount of energy is without doubt developed in the cyclone itself; but the cyclone is governed to a very large extent by the anticyclone. At Washington it is held that the anticyclone is much the more powerful of the two. It has also been ascertained that they sometimes extend to 6½ miles, although formerly it was thought they were much thinner. Professor Dobbie held that a cyclone was a vast eddy between two currents — the polar and the equatorial—but that view is somewhat modified now. In all cyclones one side is dry and cold, and the other moist and warm; the reason being that the cyclone sweeps before it all the warm surface air and brings down in its wake higher, and therefore drier and colder, air. As there is greater violence of winds in cyclones than in anticyclones, there must be some strong source of energy in the cyclonic areas. It is still evident that to a great extent "the wind bloweth where it listeth and no one can tell whence it cometh and whither it goeth," as was said two thousand years ago. Yet, as Mr. Aitken has been able to calculate the particles of dust in the air, which were considered to be "numberless," he may yet be able to lay down some sound general laws for the regulation of the cyclones and anticyclones to which he has for some time been giving his valuable attention.—J. G. McP.

ENTOMOLOGICAL.—Professor Wheeler's observations on American "driver" ants and their "guest" beetles (mentioned in KNOWLEDGE for February, pp. 32-3), have been followed by the publication of a valuable paper on the same subject by Father Wasmann, in the *Zoolog. Jahrb.* (*abt. f. Syst. u.s.w.*), XIV., 1900, pp. 215-289, pls. 13, 14). The inquilines described in this paper are rove beetles (Staphylinidæ). A new genus, *Ecitogaster*, found in the nests of a Brazilian *Eciton*, is believed to live in complete harmony with the ants and to be fed from their mouths. In return the beetles provide their hosts with an oily food-substance secreted by fat-cells beneath the cuticle of the abdomen. *Ecitogaster* is quite unlike the ants in appearance, but the beetles of another new (allied) genus, *Ecitophya*, closely mimic the large workers of *Eciton foreli* (in whose company they live), not only in form (*see* p. 33 *ante*) but also in colour. These workers have simple eyes, and presumably therefore a colour-sense. The African driver-ants (*Anomma*) harbour guest-beetles referred to a new genus *Sympolemon*, which seem to bear the same relationship to them as *Ecitogaster* to *Eciton*. A very wonderful adaptation in these beetles is the presence of two deep longitudinal grooves on the forebody shield (pronotum), affording hold for the mandibles of the ants and enabling them to carry the beetles with them on their expeditions. Comparing the guest-beetles of the driver-ants in the Neotropical and Ethiopian regions, Father Wasmann points out the analogy between the types of inquiline which have been developed both in the Eastern and in the Western Continent. Comparing the guest-beetles of the South American with those of the North American *Ecitons*, he concludes that the symbiosis is less highly developed in the latter, and that the beetles have not therefore accompanied their hosts from the south, but have adapted themselves to an inquiline life since the ants immigrated into North America.—G. H. C.

ZOOLOGICAL.—The shoe-bill or whale-headed stork (*Balæniceps rex*), ever since its discovery by Mansfield Parkyns on the White Nile in 1849, has excited great interest. In 1860 Petherick brought home two live specimens, which were exhibited in the Zoological Gardens and attracted much attention by their singular aspect. Outwardly the bird is chiefly remarkable on account of its enormous bill, which is shaped somewhat like the head of a whale, hence one of its names, but it is in other respects distinctly weird-looking, having a gaunt grey body, long legs, and a large head surmounted by a little curled tuft, and a scowling expression of the eyes. It has many structural peculiarities which anatomists have had few opportunities of examining owing to the great rarity of the bird in collections. The British Museum, for instance, up to a few months ago only possessed one skin. The bird itself is sufficiently numerous in the great marshes of the White Nile south of Fashoda, but it is extremely shy and difficult of approach. Since our reconquest of the Soudan several specimens have been obtained on the tributaries of the White Nile, while just lately Sir Harry Johnston has sent to the British Museum a specimen of the bird shot at Entebbe, on the north shore of Lake Victoria, East Africa. Great interest attaches to this specimen, which is now on exhibition in the British Museum, because hitherto the only known locality for the shoe-bill was the White Nile, to which river it seemed to be entirely confined.

At a recent meeting of the Linnean Society, Prof. E. Ray Lankester read a paper on the systematic position of *Æluropus melanoleucus*, with notes on its osteology by Mr. Lydekker. The animal in question is an inhabitant of eastern Tibet, and has hitherto been very generally regarded by English zoologists as an

XUM

aberrant kind of bear, distinguished by its black and white coloration, and the peculiar structure of its teeth. The author now showed that it is really a near relation of the panda (*Ælurus fulgens*), of the Eastern Himalaya, with which it agrees very closely in the structure of the skull and limb-bones. Both animals may now be regarded as members of the, otherwise, American family Procyonidæ (raccoons), of which they will form an aberrant group. For the true panda the name of Himalayan, or long-tailed panda may be adopted, while for the other animal the title of great, or short-tailed panda will be appropriate.

The origin of mammals, as deduced from a study of the occipital condyles of the skull, forms the subject of an important paper communicated by Professor H. F. Osborn to the *American Naturalist* for December. In reptiles the condyle by which the skull articulates with the vertebral column is single, although composed of three elements, whereas in amphibians and mammals the articulation is formed by a pair of condyles. Nevertheless, according to the author, it is the tripartite reptilian condyle which, by the loss of its median element, has given rise to the paired mammalian condyles. Hence mammals trace their descent to reptiles.

WHERE FOUR MOUNTAIN RANGES MEET.

By E. Walter Maunder, F.R.A.S.

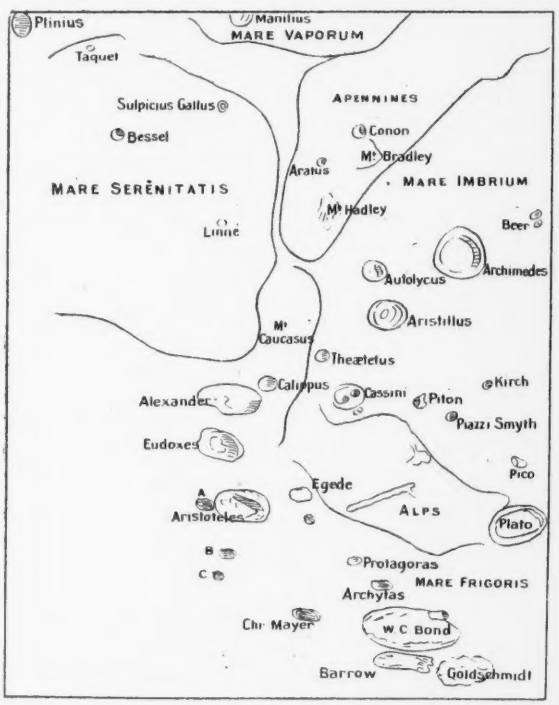
The negative from which the accompanying plate is derived was taken by MM. Loewy and Puiseux at the Paris Observatory, on September 19th, 1894. To the left lies the deep Mare Serenitatis, whose western border is already in night, and to the right is seen a portion of the Mare Imbrium, the greatest of all the lunar seas. Bordering upon and separating the two lunar seas are the four great mountain ranges of Haemus, the Apennines, the Caucasus, and the Alps. The Sea of Cold lies to the north of the Alps, and beyond that again, bordering on the lunar pole, is a mountainous region containing many large but little known ringed plains.

The grazing illumination on the terminator shows up well a characteristic feature of the Mare Serenitatis. This is a ramified welt-like structure, whose main ridges lie roughly along the meridian. The effect on the floor of the sea is like the swollen veins on the temple of an angry man. On these ridges the craters, as a rule, seem to lie; thus Bessel is on the crossing of two such ridges, but the effect given is not that the ridges spring or radiate from the craters, but rather that the craters are incidents in the trend of the ridges. A crater does not seem to modify the ridge even in its immediate neighbourhood, nor to alter its course. It is otherwise when the ridge enters the Alpine range, or rather the range of mountains that is manifestly of the same formation as the Alps, which lie to the east of the Caucasus. Here the great ridge, on which Bessel lies, and which can also be faintly traced south as far as Menelaus, is abruptly transformed into a trench, a long straight even valley cutting through the rugged highlands, in a direct prolongation of the ridge that lies on the floor of the Sea of Serenity. The Haemus mountains lie too close to the southern edge of the picture for us to trace whether a similar transformation takes place beyond Menelaus, but other like instances can be traced in this plate in the Alps—notably a bright ridge from Egede A, in the Sea of Cold, runs as straight as rule could draw it into the great valley of the Alps.

Besides the ridge on which lie Bessel and Menelaus, there is another great system which in the present photograph seems to outline the Mare Serenitatis to the west. The sea, however, extends some distance in a still more westerly direction, but this portion is in the darkness of after-sunset.

Although the Mare Imbrium is closely connected with the Mare Serenitatis by the wide and deep pass that divides the Apennines from the Caucasus Mountains, its western portion, which is shown in the photograph, differs in all its characteristic features from the deeper sea. It is not only that it contains such huge ringed plains and craters as Archimedes, Autolycus, Theætetus, Aristillus and Cassini, the smallest of which is a giant compared with Bessel, the chief in the Sea of Serenity; but the influence of these craters on the floor of the sea has been very marked. The floor to the south of Archimedes is rugged and heaped up for a space four or five times the area of the ringed plain itself. From Aristillus broad high ridges extend to the four surrounding craters, and round Autolycus there is a series of brightly illuminated aureoles.

Like two fortresses, Autolycus on the east and Linné on the west stand guarding the broad deep pass before-



mentioned, which divides the Apennines and the Caucasus. Autolycus lies about twice its own diameter from the entrance to the pass, but the western portion of its "aureoles" abut on the outlying boulders of the mountain ranges In the very entrance to the pass there is faintly seen a semi-circular rampart, like an almost submerged Cassini whose eastern half has been pressed down and covered over by the invading "aureoles" of Autolycus. On the western side, Linné preserves the same distance from the pass that Autolycus does on the east, and here again we seem to see, but more faintly still, the indications of an early ringed plain almost stamped out by the influence of Linné. This region is the more interesting from the suspicions of change in it since it was observed by Riccioli.

Only a portion of the Mare Imbrium is seen in the photograph, that including the Palus Putredinis and the

XUM

SOUTH.

WEST. EAST.

NORTH.

WHERE FOUR MOUNTAIN RANGES MEET.

From a Photograph taken 1894, September 19th, 14·1h. Paris Mean Time, with the Great Equatorial Coudé of the Paris Observatory.
Scale :—Diameter of Moon, 24 inches. Moon's Age, 20d. 5·9h.

XUM

XUM

Palus Nebularum. The first is seen as a rather shallow depression, stretching from Archimedes south-west to the Apennines, and cut off from the rest of the sea by the high rugged ground that seems to have overflowed from Archimedes on the south, and by the "aureoles" of Autolycus on the north. The Palus Nebularum lies north of Aristillus, and is bounded by the ridges which connect that great ringed plain with Autolycus on the south and with Cassini on the north.

The Sea of Cold is too much foreshortened for the detail on its floor to be clearly made out. It would seem to resemble the Sea of Serenity rather than the Sea of Rain, and the position of Egede A on its intersecting ridges certainly seems to recall the position of Bessel.

Distant as Autolycus, Aristillus and Cassini are from the Caucasus mountains, they yet seem to have exercised some local influence on them. MM. Loewy and Puiseux point out that if lines are drawn parallel to that from Autolycus through the great pass, through the centres of Aristillus, Theætetus, Cassini and Eudoxes, these lines will all lie along depressions in the mountain range. Another feature that they point out is the deep depression that occurs at the outside base of the craters and of the mountain ranges. This is well seen round Archimedes, along the base of the Alps west from Plato, both on the north side and on the south, and most markedly on the eastern side of the Caucasus where it crosses the Alps, and distinctly, though less markedly, on the western side. These two depressions in the meridian line crossing the five depressions which pass through the great craters of the Sea of Rain, and through Eudoxes, divide up the Caucasus range into four great rectangles, and the mountains north of Eudoxes are so divided from the rest of the range that they appear but as isolated peaks.

The two most important and most beautiful ringed plains shown on the photograph are those of Archimedes and Plato. Of nearly equal size, both have the same regular almost unbroken rampart, both have their interior plains but slightly depressed, but the floor of Archimedes is brilliant, and the curious dark bands as it crosses the meridian at right angles are easily seen. The floor of Plato, on the other hand, is very dark, and no detail can be made out in this photograph. MM. Loewy and Puiseux attribute the bands on the floor of Archimedes to the influence of the two large adjacent craters, some pointing towards Aristillus and some to Autolycus. Plato, the "Black Lake," as Hevelius called it, is the best example of those plains which become relatively darker as the age of the moon increases.

CONSTELLATION STUDIES.

By E. Walter Maunder, F.R.A.S.

IV.—BOOTES AND HERCULES.

Three bright stars rule the northern heavens, three stars so equal in magnitude that our highest authorities differ as to the order in which they should be classed in brightness. All three are above the horizon in the April midnight, but whereas Vega and Capella are comparatively low down in the east and west respectively, Arcturus is now approaching the meridian.

Arcturus is one of the easiest stars to recognise in the entire sky. If we start from the Pole Star, we find that the last star in the Plough Handle is just halfway to Arcturus; or the curve of the three stars of the handle of the Plough, if continued, seems to bring us round to the same place; or reverting to our two last studies, Denebola of Leo and Spica of Virgo and Arcturus mark out a triangle, almost equilateral.

The star owes its name to its nearness to the Bear. It is Arcturus, the "Watcher of the Bear." It is now the brightest star in the constellation Bootes, the Herdsman, but in the catalogue of Ptolemy it is not included in the actual figure, but is an "unformed" star below him. There seems to have been some reason for this exclusion, for Theon and Hesychius call Bootes, Orion, and when Arcturus is excluded, the principal remaining stars of the constellation make up a representation, pale and distorted it is true, but a representation for all that of the most glorious constellation of the sky. This circumstance may explain an allusion in Isaiah xiii. 10, which has puzzled many commentators, "The stars of heaven and the constellations thereof." The word "constellations" is in the plural, and is the same word which is in the singular in Job ix. 9, Job xxxviii. 31, and Amos v. 8; and which is in each case translated with great probability "Orion." Here then it may stand for the two Orions, Bootes being one. However this may be, the resemblance between the two constellations will be near enough to help the student to trace out the figure. Arcturus stands nearly midway between the Herdsman's two legs, marked respectively by the stars Eta and Zeta; above Arcturus are the three belt stars, Rho, Sigma, and Epsilon, Epsilon being much the brightest. Above we find Gamma and Delta marking the shoulders, whilst Beta takes the place of the cluster of small stars which denotes the head of Orion.

Arcturus and Gamma form two points of an equilateral triangle with Epsilon in the centre; the third point is formed by Alphecca, the Broken Platter. The reason of the name is readily seen, since right and left of Alphecca are four other stars, two on each side, making up a semicircle, and suggesting to the old Arabian star-gazers a broken plate held out by a beggar to receive alms. This very sordid title contrasts poorly with its classical name,

> "That Crown which Dionysos placed
> Of Ariadne dead, a glorious sign."

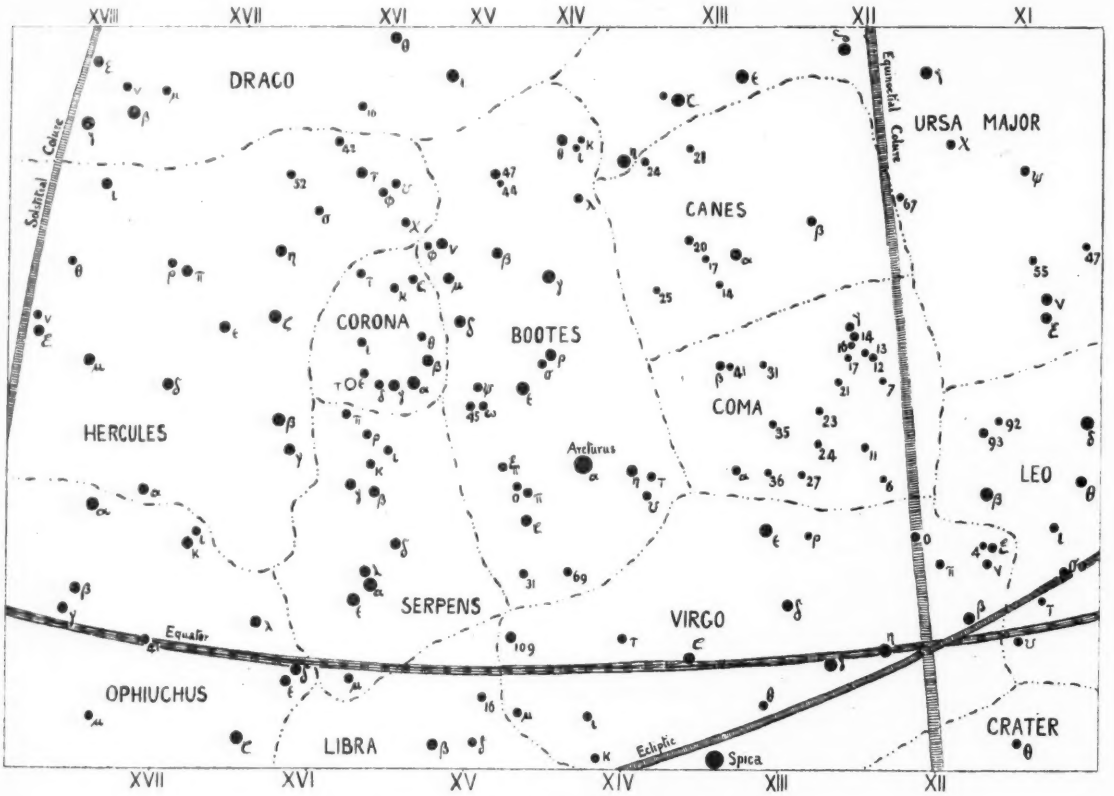
The constellation though so small is, from its shape and its nearness to Arcturus, very easy to find. Or the old rhyme may guide us if we turn back to Virgo, and pick out Epsilon, the "Herald of the Vintage."

> "From Epsilon in Virgo's side, Arcturus seek and stem,
> And just as far again you'll spy Corona's beauteous gem;
> There no mistake can well befall e'en him who little knows,
> For bright and circular, the Crown conspicuously glows."

The small size and neat arrangement of Corona make it a pretty object for the opera-glass; and in 1866 it afforded a grand chance for the naked-eye observer. For on the night of May 12th, in that year, the constellation suddenly presented an unwonted shape. Epsilon, the star of the five furthest to the east, was overshadowed by a new and bright companion which outshone Alphecca. This was T Coronae, the first "new star" to appear since the invention of the spectroscope. Less brilliant than the new star in Perseus which has so suddenly blazed out upon us, it created, as the first example of the kind that had occurred in the new era of astronomy, an even greater sensation; and the discovery in its spectrum of the bright lines of hydrogen aroused the utmost interest. Six novæ have appeared since the date of T Coronae, including the one so recently discovered by Dr. Anderson. So far, however, as the relatively incomplete observations of its spectrum changes go, they seem to point to T Corona being a nova of a different order from those which have succeeded it.

A line from Gamma Bootis through Theta Coronae, the most westerly of the five stars of the "Broken Platter," brings us, at an equal distance beyond, to Beta in the constellation of the Kneeler. This is not a brilliant

constellation, having no stars so bright as the second magnitude, but it can be pretty easily traced out. Taking Beta and the somewhat fainter star Gamma, just below it, as the root, the stars map out the calix of a gigantic lily; Gamma, Beta, Zeta, Eta, Sigma and Tau, six stars in a beautiful curve, sweeping round the little constellation of the Crown, forming the western outline of the flower. Hercules is the name now universally ascribed to this



Star Map No. 4; The Region of Bootes and Hercules.

constellation, but the name was foisted upon it in comparatively recent times Aratus sings:—

"A labouring man next rises to our sight,
But what his task or who this honoured wight
No poet tells. Upon his knee he bends,
And hence his name, Engonasin, descends.
He lifts his suppliant arms and dares to rest
His right foot on the scaly dragon's crest."

The first suggestion that this Kneeler was the great national Hellenic deity, seems to have been due to Panyasis, the uncle of the great historian, Herodotus. In a poem on the subject of the great national hero, in order to do him the greater honour he sought to identify him with the unnamed wrestler of the constellation. The fact that despite this effort the identification had entirely failed of adoption 200 years later, is as near positive proof as we can get, not merely that it was not known whom the constellation represented, but that it was known that it did not represent Hercules

The second curve of Hercules runs through the stars Gamma, Beta, Epsilon, and Pi and Iota; Iota making a diamond with the three stars in the Head of the Dragon, Beta, Gamma and Xi. This diamond, Proctor, in his ingenious but usually quite unauthorised alterations of the current outlines of the constellations, regarded as making the true Dragon's Head.

The third curve of the great lily of Hercules extends from Gamma and Beta, through a well marked line of stars, Delta, Lambda, Mu, and Nu, to the little constellation of the Lyre, the principal star of which is the great blue brilliant Vega, the worthy rival of Arcturus and Capella, if not superior to either. The brightness and the intensely blue light with which it shines render Vega a very easy object to pick up, but if an alignment is required, a straight line from Arcturus through Alphecca to Zeta Hercules leads almost straight to it, Zeta being halfway.

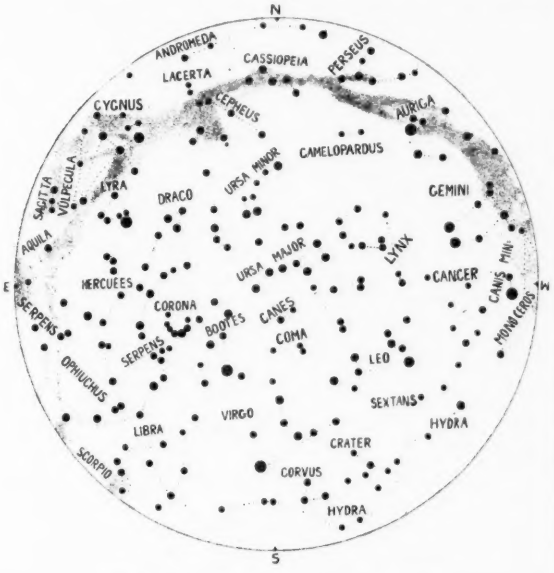
"There is the Shell but small. And this, whilst yet
Encradled, Hermes pierced and called it Lyre;
Fronting the Unknown Form" (*i.e.*, the Kneeler) "he set it down
When brought to Heaven."

The principal stars of the constellation are very easy to recognise. Vega forms one of the points of a little equilateral triangle, the other two angles of which are occupied by Epsilon and Beta. Epsilon is to very keen sight a naked-eye double; the opera-glass separates the two stars at once, and no great telescopic power is required to show each star as itself a neat little pair. Zeta marks also the upper angle of a little rhomboid, of which Beta, Gamma, and Delta mark the other angles. Each of these stars is an easy double for the opera-glass; Nu and Lambda being companions to Beta and Gamma respectively. Beta is one of the most interesting of short period variables; its period being two hours short of thirteen days, in which time it passes through two maxima and two minima, the minima being, however, of unequal brightness; but as even

when faintest it is of magnitude $4\frac{1}{2}$, it is always well within the grasp of the naked-eye observer.

The Milky Way flows across the S.E. angle of the constellation, and this, with its dazzling leader, its numerous pairs, its beautiful fields and wonderful variable, renders it a fine region for the opera-glass observer. To the naked-eye astronomer, it is also noteworthy as the home of the swift meteors of April 20th—the Lyrids—their radiant point being just on the boundary line between Hercules and Lyra.

The constellation is always shown now as an eagle with a harp slung round its neck, and the name of the principal



The Midnight Sky for London, 1901, April.

star, Vega, refers to this design, since it comes from the last word of the Arabic expression, *Al nesr al waki*, the "falling" or "swooping eagle"; in contrast to Aquila, the principal star of which we now call Altair, that is to say, *Al nesr al tair*, the "flying," that is, the "soaring eagle."

The head of Hercules is marked by a beautiful orange coloured star, Alpha Herculis, Ras al gethi, the "head of the Kneeler," forming the southernmost point of a lozenge of which Beta, Zeta and Delta Herculis are the other three points. Alpha Herculis is notable in the spectroscope as presenting one of the finest examples of the third or banded type of spectrum.

Notices of Books.

"A Text-Book of Zoology, treated from a Biological Standpoint." By Dr. O. Schmeil. Translated by R. Rosenstock, and edited by J. T. Cunningham. Part III. (A. and C. Black. 1900.) Price 3s. 6d.—The two previous parts of this work were noticed in our November issue, where reference is made to the general scope of the work, and the class of readers for whom it is intended. The present part, which treats of Invertebrates, completes the work. Were it not for the unaccountable omission of certain most important groups, such as the Brachiopods and the Tunicates, not to mention that most remarkable worm *Balanoglossus*, we should have been enabled to bestow higher commendation on this portion of the work than, as matters stand, we feel justified in doing. If, however, we discount these omissions, there is little doubt that the subject as a whole is treated in a satisfactory manner, and in a way which can scarcely fail to prove attractive to the pupil. As in the earlier parts, attention is concentrated on physiology and habits rather than on morphology; and the descriptions of the transformations undergone by insects, as well as of the marvellous developmental history of the numerous kinds of intestinal and other parasitic worms, are all that can be desired. The illustrations, too, are well selected, and for the most part satisfactory from an artistic point of view. At the conclusion of the descriptive part of the work, two pages are devoted to the geographical distribution of animals. While there are many aspects in which it might be amended with advantage, the work as a whole has undoubtedly many merits, and it is a marvel of cheapness.

"The Child: A Study in the Evolution of Man." By A. F. Chamberlain, M.A., Ph.D. (Walter Scott.) Illustrated. 6s.—The sub-title appears to us to express the scope of the contents of this book better than the first two words. The child is described in many of its aspects, but more as a stage in the evolution of man than as a special problem. The book is thus more adapted to the point of view of the student of organic development than that of the kindergarten or other teacher interested in child-study. Broadly speaking, the mental stages through which a person passes in the course of a lifetime can be represented by similar stages in the psychological development of a race. Man begins at the very bottom of the ladder, both as regards body and mind, and slowly crawls to maturity. Dr. Chamberlain traces this progress with particular reference to psychological characteristics, and shows how it can be interpreted by the principles of evolution. The book is full of material for reflection, and suggestive ideas, but it might have been condensed to half its present dimensions without losing any of its force. Much of the matter seems to have been included more because it was available than because it was relevant to the subject. A teacher of psychology was once defined by a child as "A man who tells us what everyone knows in language which nobody can understand," and to this we may add that many psychologists elucidate and classify results which are of little value, even when they are understood. Take, for instance, the drawings which are often described and illustrated as representing the ideas of children. Such sketches of course do not show the images the child wishes to portray, but the movements of a hand as yet unable to trace the workings of the mind. A similar criticism may be applied to the answers which some psychologists are fond of obtaining from children, with the view of determining the course of mental development. However, Dr. Chamberlain deals with many other matters, and his book contains much that is interesting concerning normal and abnormal man, from childhood to old age.

"Botany, an Elementary Text for Schools." By L. H. Bailey. (New York: The Macmillan Company.) 1900. Illustrated.—With a clearer understanding of the importance of scientific methods of elementary teaching, there has arisen a demand for elementary treatises which is far from being satisfied by the works with which, in many branches of science, teachers have still to rest content. We have no hesitation in saying that Prof. Bailey's elegant and beautifully illustrated volume approaches nearer to our ideas of what a school-book of Botany should be than any that we have hitherto met with. No one doubts now that the beginner should approach the study of plants in the field and not in the laboratory, with hand and eye rather than by the aid of razor and microscope. That the author fully realises this he makes clear in the preface:—"The pupil should come to the study of plants and animals with little more than his natural and native powers. Study with the compound microscope is a specialization to be made when the pupil has had experience and when his judgment and sense of relationships are trained." The plant is set forth as a living organism, and the pupil is led to study it where and as it grows. With this part of the subject the first twenty-five chapters (200 pp.) are concerned. If these chapters are read and illustrated in the field, they must impart that living interest in living plants which is essential if the study of Botany is to have that educational value which it possesses when directed by a wise teacher. Five chapters are devoted to a consideration of relationships between the plant and its physical and organic surroundings. The economics of plant societies, the great biological interest of which is the outcome of recent research, are briefly and clearly considered. In

the last six chapters the intimate structure and the classification of plants are dealt with. One of the most remarkable features of the book is the abundance and excellence of the illustrations, many of which are quite unique in a work of this character. It may perhaps be considered that the volume is over-illustrated. Copious representations of Nature in a school-book of Botany are not unlikely to supplant field observations, and thus prove themselves a snare rather than a blessing. We trust that this work is destined to become well known in this country, and therefore the more regret that its usefulness is impaired by the use of popular (American) names of plants which are quite unintelligible to the British reader. The botanical names in brackets would have been of great assistance both to teachers and scholars. These and a few other minor defects do not seriously detract from the excellence of Prof. Bailey's work, which we have read with great pleasure, and can heartily recommend to those who seek a first-class school-book of Botany.

BOOKS RECEIVED.

Practical Organic Chemistry for Advanced Students. By Julius B. Cohen, PH.D. (Macmillan.) Illustrated. 3s. 6d.

Report on the Census of Porto Rico, 1899. (Washington: Government Printing Office.)

The A B C of Dynamo Design. By Alfred H. Avery. (Dawbarn & Ward.) Illustrated. 1s. net.

Model Boiler Making. By E. L. Pearce. (Dawbarn & Ward.) Illustrated. 6d. net.

Sartor Resartus. Heroes and Hero-Worship. Past and Present. By Thomas Carlyle. (Ward, Lock.) 2s.

Researches on the Past and Present History of the Earth's Atmosphere. By Dr. Thomas Lamb Phipson. (Griffin & Co., Ltd.) 2s. 6d.

The Child: His Nature and Nurture. By W. B. Drummond, M.B., C.M., M.R.C.P.E. (The Temple Cyclopædic Primers.) (Dent.) 1s. net.

First Aid to the Injured and Ambulance Drill. By H. Drinkwater, M.D. (The Temple Cyclopædic Primers.) (Dent.) 1s. net.

The Complete Works of John Keats. Vol. IV. Edited by H. Buxton Forman. (Gowans & Gray.) 1s. net.

Whist Dialogues. By Major Jack Tenace. (Bruxelles: Imprimerie E. Wagemans.)

An Enquiry concerning the Principles of Morals. By David Hume. (Kegan Paul.) 1s. 6d.

The Value of Scientific Training. By Prof. J. Logan Lobley, F.G.S., F.R.G.S. (Cowell.)

The Structure and Inherent Motions of the Universe. By Edward Meyer. (Adelaide: A. & E. Lewis.)

The Photo-Miniature, January, 1901. (Dawbarn & Ward.) Monthly, 6d.

Paper Work. By Rev. F. C. Lambert, M.A., and Charles Godfrey Leland, M.A., F.R.S.L. (Dawbarn & Ward.) 6d net.

Seventeenth Annual Report of the Bureau of American Ethnology to the Secretary of the Smithsonian Institution, 1895-6. Part II. (Washington: Government Printing Office.)

Catalogue of Chemical Apparatus, &c. (London: Gallenkamp & Co., Ltd.) 2s.

Thornton-Pickard Photographic Specialities. (Thornton-Pickard Manufacturing Co., Altrincham.)

The Norwegian North Polar Expedition, 1893-1896—Scientific Results. Edited by Fridtjof Nansen. Vol. II. (Longmans.) 30s. net.

Letters.

[The Editors do not hold themselves responsible for the opinions or statements of correspondents.]

SUNSET PHENOMENON.

TO THE EDITORS OF KNOWLEDGE.

Sirs,—I think Mr. E. W. Maunder, in his note appended to Mr. McDonald's letter on the above subject, treats the matter possibly a little too cursorily, in stating that the rays are rarely traced right across the sky. In the dry uplands of South Africa, in the brilliant dry weather one gets in winter, I have night after night observed these lovely pink streamers stretching right across the sky, and meeting at a point opposite the sun's position; and I have often speculated as to their origin. They would never be quite the same two evenings running; sometimes there would be several of these rays, well defined, all a beautiful pink, contrasting exquisitely with the pale blue of the twilight sky. Next evening there might perhaps be one huge fan-like one stretching laterally over many degrees of the sky, with one or two narrow ones. I quite admit that they are exactly analogous to the rays of the sun piercing an aperture in clouds, which cut off his direct light from the space surrounding the cylinder of atmosphere illuminated directly. But the difficulty always occurred to me, where were the clouds that produced the streamers or rays, because we knew for certain (in the Transvaal where I was then stationed) that in the winter season the whole sky, over an enormous tract of country, was absolutely free from cloud. Those who have lived in the country referred to will, I think, appreciate this question.

I have dwelt on this topic before, in the columns of the *English Mechanic*, and observed I should like to see the subject treated scientifically. Query: At what distance should clouds be situated from the observer to produce the effect of these pink streamers shortly after sunset? Of course the exact time would have to be given, in order to ascertain the depression of the sun, at that time, below the horizon. Also, is it not possible that the rays might be caused by the sun's light passing over ranges of broken hills and mountains which abound in South Africa? The valleys between mountains might admit the tangential rays of the sun, while the mountains would cut them off. I have by me a water-colour sketch of the Magaliesburg Range taken from a spot a few miles distant from Pretoria. The horizon goes up and down, as peak and valley are defined in the clear blue distance, and the gorge where the Crocodile River cuts through the range is sharply marked. Might not such irregularities in districts somewhat beyond the terrestrial horizon be the cause of the pink streamers?

In some cases this phenomenon is no doubt due to clouds, for I find that when at sea, in the year 1885, I noticed a curious effect one evening just after sunset; the left hand part of the sky (looking westwards) was ruddy, while the right was a beautiful turquoise hue. This was undoubtedly only a form, or special case of the pink streamers, but in this case mountains could not be brought in as the cause, as we were at the time far from land; and clouds must have been the cause. In England one does not often see the streamers stretching across the sky, and meeting at the point opposite the sun. I seem to recollect only one occasion.

They usually take the form of a fan, and are so represented in landscapes; sometimes radiating upwards and sometimes downward, the sun being generally supposed to be above the horizon at the time.

This phenomenon is quite distinct from the "pink glows," when the *whole* of the western sky is illuminated with a pink glow, verging through orange to coppery red near the horizon. This is due to either aqueous vapour or fine dust disseminated in the upper regions of the atmosphere under peculiar conditions.

E. E. Markwick (Col.).

Devonport, 10th March, 1901.

"MRS. QUICKLY'S TABLE OF GREEN FIELDS."

TO THE EDITORS OF KNOWLEDGE.

Sirs,—Surely a "table of green fields" is the correct reading. Dame Quickly, whose mind could not soar above the most homely ideas, was thinking (or, rather, Shakespeare was thinking for her) of a map of a country parish, on which the size and positions of its several fields are marked—the map is called a "Terrier" from *terra*—and she meant that Falstaff's nose was so wrinkled and indented with lines as for it to be com-

parable to such a map. The comparison occurs in at least two other places in Shakespeare, *e.g.*, Maria says of Mavolio (Act III., Sc. 2), "He doth smile his face into more lines than are in the new map, with the augmentation of the Indies"; the same idea being presented in Henry IV., II., 5, 1, by "He shall laugh till his face be like a wet cloke ill laid up." Again, in "The Rape of Lucrece,"

> "She turns away
> The face, that map which deep impression bears
> Of hard misfortune carved in it with tears."

Also in Titus Andronicus, it is said to the woe-begone Lavinia, "Thou map of woe!" and in another play we have "Thy face, the map of honour." Shakespeare, like other writers, uses the word "table" in the sense of a surface on which something is painted or drawn, *e.g.*, "I beheld myself Drawn in the flattering table of her eye"; and, again, "Who art the table, wherein my thoughts Are visibly charactered and engraved." He also speaks of the (second) table of the commandments. Byron has, rather incorrectly, "A moment o'er his face A tablet of unutterable thoughts Was traced."

Dame Quickly, then, means that Falstaff's erstwhile "jolly red nose" had shrunk and become pointed and wrinkled. H. Algar.

TO THE EDITORS OF KNOWLEDGE.

Sirs,—Attempts to explain Mrs. Quickly's "table of green fields" have not been so successful as to exclude others.

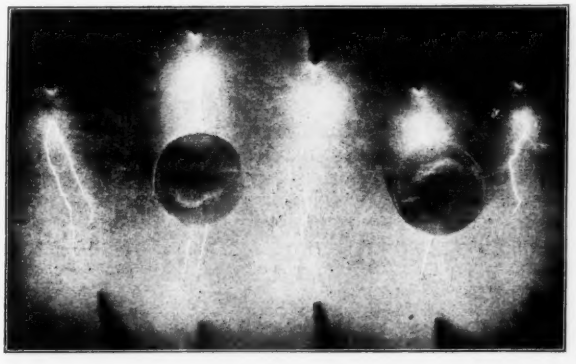
May I suggest the omission of the "b" in "table," leaving "tale." John James Coulton.

Pentney, Narborough, Norfolk,
February 22nd, 1901.

A CURIOUS ELECTROGRAPH.

TO THE EDITORS OF KNOWLEDGE.

Sirs,—The rather curious negative of which I send a print was obtained in this way. My laboratory was converted for the occasion into a "dark room." A dry plate was laid on a stand without protection of any sort. The gutta-percha covered wires from my Wimshurst machine were placed upon it alternately in positions 1, 2, 3, 4, and 5, as the print shows. The impressions shown in positions 2 and 4 were produced



1 2 3 4 5

by a shilling likewise laid upon the dry plate "head" downwards. Two sparks were sent through positions 1 and 2, four through positions 3 and 4, and one spark through position 5. I expected to get in the places of the coin impressions of roughly circular blanks. The first puzzle, then, in connection with the performance is,—how comes it that the "head" shows at all? The phalange round the edge of the coin was unquestionably good. Next: how is it that the face in profile is almost equally illuminated in either position? In position 2 it is turned towards the negative wire and receives two sparks; in position 4 it faces the positive and gets 4 sparks. Without a doubt the general effect of illumination is better in 2 than it is in 4, but it is equally clear that in the former case the wires are farther apart. For some mysterious reason the back of the head in position 4 fails to appear at all.

The glow at the end of the gutta-percha covering of the positive wire is also curious. Why should leakage be more decided there than it is apparently along the course of the uncovered wire? William Godden.

38, Burrard Road,
West Hampstead, N.W.,
January 20th, 1901.

THE NEBULAR HYPOTHESIS.

TO THE EDITORS OF KNOWLEDGE.

Sirs,—I gather from Sir Robert Ball in his "Great Astronomers," that one of the factors which led La-Place to propound his nebular hypothesis was the fact that all the planets and their satellites (that were then known), comprising some thirty circular movements, travelled and rotated in the same direction in which our earth is known to do, viz., from west to east.

I should be extremely obliged if you could inform me through the medium of your valuable journal, which I have read with such pleasure for the past fifteen years, whether the nebular hypothesis is in any way damaged by the discovery that one or more of the satellites of Uranus travel round it in the opposite direction, viz., from east to west, and can such a diverse movement be accounted for. As this question arose at a Literary Society Meeting, when the nebular hypothesis was being discussed, and remained unsolved of course, I decided to seek information at the fountain head.

H. Christopher.

[Necessarily, a theory like the nebular hypothesis can deal only with the facts as we know them at the time, and new facts as they are brought to our knowledge have to be recognised, and it may be that the theory has to be somewhat modified to include them. M. Faye, for instance, in his form of the cosmogonic theory, supposes that the solar system at an early period consisted largely of separate meteorites, which arranged themselves in process of time in flat and nearly circular rings round a small central nucleus. Whilst the nucleus —the future sun—was small, the rings moved as a rigid whole, the outer meteorites of any ring moving absolutely faster than the inner. Consequently when a planetary mass was aggregated out of any ring at this period, the tendency of the planet and its satellites was to assume a direct rotation. As the sun grew the tendency in each ring yet uncondensed was for the outer meteorites to move less rapidly than the inner, and hence to form planetary systems rotating retrogradely. Therefore, according to M. Faye, the earth and all the planets up to Saturn are much older than the sun, but Uranus came into being when the two tendencies were about balanced, and consequently its satellites revolve in a plane almost perpendicular to that of the planet's orbit. Neptune would seem to have come into existence later still. It is, however, only fair to point out that there

are very considerable difficulties attaching to M. Faye's form of the theory. I give it only as an example of one way in which it has been attempted to explain the fact to which Mr. Christopher alludes.—E. Walter Maunder.]

IS HUMAN LIFE POSSIBLE ON OTHER PLANETS?

TO THE EDITORS OF KNOWLEDGE.

Sirs,—Referring to Mr. Thomas R. Waring's reply to Mr. A. D. Taylor's query, "Is human life possible on other planets?" he states that Mars' atmosphere is thin, and consequently free from clouds. In Wells & Gregory's Honours Physiography, as well as in various other books, it is stated that Mars possesses clouds which are visible in the large telescopes as dark moving patches. I should like to know which of the above is right. If Mars possesses no clouds on account of its thin atmosphere, I should like to know what atmosphere has to do with clouds. E. Lloyd Jones.

Blaenau Festiniog.

[I do not remember the passage in Wells and Gregory's Physiography, but it should be pointed out that clouds on a planet in opposition would necessarily appear as extremely bright bodies, not dark; whilst it is in the last degree improbable that any cloud motions could be perceived. A white spot upon Mars might conceivably be due to snow, hoarfrost, or cloud, and it would be quite impossible for us to discriminate at our immense distance from the planet between the three. On our earth dense and widely extended clouds are confined to the lower regions of the atmosphere. The upper strata, which approximate in tenuity to what we can conceive of the atmosphere of Mars, support nothing but thin cirrus clouds, which could not possibly be discerned as such across 40 millions of miles.—E. Walter Maunder.]

HUMAN FINGER-PRINTS.

TO THE EDITORS OF KNOWLEDGE.

Sirs,—The constancy of human finger-prints has chiefly been discussed in connection with the identification of criminals. Assuming that the evidence of finger-prints is to be admissible in criminal proceedings, it will be not only necessary to prove that in the case of the same man the finger-prints remain unaltered, but that no two persons have identical finger-prints. Where is the evidence of this? There are probably 1,500,000,000 of men and women on the earth. Can we suppose that no two of these have identical finger-prints? Nor indeed is this all. We may be comparing the finger-prints of a living man with those of one who has been dead for years past, and the doctrine of heredity might lead us to expect to find similar finger-prints in the case of parents and children, and of different children of the same parents. It is, at all events, certain that if this finger-print system were once introduced into our courts of justice, there would be any amount of wrangling as to whether they were identical or only similar—experts contradicting each other and involving the whole subject in confusion. Moreover, professional criminals would probably soon find some mode of altering their finger-prints. No doubt if the person who committed a crime—a murder, for example—has left the imprint of his fingers on anything it may prove an important clue; but the same thing may be said of the imprint of his boots or shoes. But a clue is one thing and a proof is another thing.

Let me point out another difficulty. In a country where there are a large number of criminals whose finger-prints are collected, the number of these will soon be very large. How long would it take to examine this collection in order to find out whether any of them corresponded accurately with the finger-prints of the man who is now accused? The task would, I think, be a hopeless one.

That finger-prints may be important in the detection of crime whenever the criminal has left the print of his fingers behind him I do not dispute, but without much stronger evidence than we now possess that no two persons have undistinguishable finger-prints such evidence ought never to be permitted to outweigh what appeared to be a tolerably satisfactory *alibi*. As to persons guilty of repeated crimes, I do not see the justice of adding to a man's sentence on the present occasion because he has fully expiated a previous offence; while a really habitual criminal can never pose as a first offender under our present system, although some of his previous convictions may be overlooked.

W. H. S. Monck.

Conducted by Harry F. Witherby, F.Z.S., M.B.O.U.

Early Appearance of the Dotterel in Yorkshire.—Two Dotterels (*Eudromias morinellus*) were seen here on February 18th, and one again on March 2nd. These are surely extraordinary early dates for this summer visitor, which does not usually reach us until towards the end of April.—Philip W. Loten, Easington, Yorkshire, March 5th, 1901.

The Little Dusky Shearwater (*Puffinus assimilis*, Gould) in Sussex.—At the meeting of the British Ornithologists' Club, held on February 13th, a communication from Mr. Ruskin Butterfield on the occurrence of a Shearwater of this species in Sussex was read by Mr. Hartert. The bird was picked up in an exhausted condition on the beach near Bexhill during the hard gale from the W.S.W. on December 28th, 1900. Both Mr. Ernst Hartert and Mr. Howard Saunders have examined the bird, and proclaim it to be *Puffinus assimilis*. This species breeds on the islets of the Madeiran group, the Salvages, nearer to the Canaries, and also in the Cape Verde Islands. It is also found in the Australian and New Zealand seas. This is but the third occurrence of the bird in the British Isles, which indeed are far from its normal haunts, and the visits of this bird to this country can only be put down to accident.

Tawny Owl in Ireland (*Irish Naturalist*, March, 1901, p. 72).—In Knowledge for February, 1901, p. 43, a record of the occurrence of

the Tawny Owl in co. Down, Ireland, was referred to, and it was there remarked that the bird had never before occurred in Ireland. It now appears that a gentleman in June last procured nine Tawny Owls from the New Forest and liberated them in co. Down. This satisfactorily explains the presence of the bird which was shot in the county in November last. It appears also that a number of Jays have been liberated in the same way. The practice of introducing birds or animals foreign to a country and liberating them in that country cannot be too strongly condemned. From a naturalists' point of view such an act is the deepest offence, and is likely to cause almost as much harm to science as the extermination of a species in a country. The movements and geographical distribution of birds and animals is a difficult enough subject as it is without the interfering agency of mankind. What will happen in Ireland through the act of this "gentleman who takes some interest in ornithology"? All the future records of Jays and Tawny Owls in the north of Ireland will be under suspicion, and the study of the geographical distribution of the species as far as this part of the country is concerned will be at a standstill. The introducer, moreover, added to his offence by not informing naturalists of what he had done. Apart from this it would be of interest to know who broke the law in procuring these young birds from the New Forest.

Winter occurrence of House Martin in Yorkshire (*The Naturalist* March, 1901, p. 74).—Mr. T. H. Nelson observes that a House Martin appeared in front of "The Cliffe," Redcar, on December the 14th last, and was seen at intervals, flying to and fro, until the 20th, of December. Although, of course, the majority of Martins have travelled south before December, a few individuals, generally young birds, are occasionally seen in December in mild seasons. The above, however, is an exceptionally late occurrence for so far north.

All contributions to the column, either in the way of notes or photographs, should be forwarded to Harry F. Witherby, *at 1, Eliot Place, Blackheath, Kent.*

PRE-HISTORIC MAN IN THE CENTRAL MEDITERRANEAN.

By John H. Cooke, F.L.S., F.G.S., etc.

It has long been a matter of common belief that the south of Italy and the northern coast of Africa are the remnants of a land barrier which formerly divided the Mediterranean into two basins, and connected the continents of Europe and Africa.

This barrier has existed from early geological times. The nucleus of the Alps and Apennines consists of Jurassic rocks, and prior to the subsidence that ushered in the Cretaceous or Chalk period, a ridge of these rocks extended above sea-level from the north of Italy, through Sicily as far south as the island of Galita off the coast of Tunis.

During Miocene times the ridge formed a portion of the bed of an extensive ocean, and it was then enveloped with a series of limestones and clays of great thickness whose representatives may now be traced in Tunis, Malta, Sicily, Italy, and as far as the northernmost limits of the Vienna basin. The evidences which are offered of the former existence of the central Mediterranean land bridge between the two continents show that during the latter part of the Miocene period the bed of the Mediterranean, together with a large area of southern Europe, were slowly elevated. In the Maltese islands are to be found extensive deposits of Globigerina limestones which were laid down in a sea whose depth varied from one thousand to three thousand fathoms; and these deposits are overlain by a series of marls, clays, and coralline limestones, which were deposited in depths of from one hundred to ten fathoms.

A similar sequence may be traced in Sicily, Italy, and Austria where the series are overlain, in their turn, by extensive deposits of pebbles, sand, and loess of Pliocene age. The Pliocene period was a time of great unrest for the central Mediterranean.

It witnessed the birth of Etna, and the re-emergence of the land bridge between Europe and Africa. The submergence of western Europe and of the greater portion of the Mediterranean set in at its close, and, besides forming the islands of Malta and Sicily, it laid down the breccias and loess, which extend over such large tracts from the Urals to the Pillars of Heracles.

Proofs of these physical changes are reflected in the sequence of the beds of the district, in the zoological contrasts and affinities of the fossils, and in the mingling of northern and southern forms of animal and plant life, fossil and recent, in the caves and superficial deposits on either shore of the Mediterranean.

The central Mediterranean barrier is now in part submerged, the only visible remnants being Sicily, the Maltese islands, and a few islets off the African coast, but the depth of the submergence is not great, being least between Malta and Sicily, and greatest between Malta and the African coast. An elevation of this portion of the Mediterranean floor to a height of sixty fathoms would re-establish the old continental connection.

The region offers a rich field of research to the geologist, and its problems suggest many interesting questions to the antiquarian. Rude stone monuments, implements, burial places and other records of the existence of primitive man in the area are surprisingly numerous. Within the last twenty-five years attempts have been made to classify the relics that have been found, and to trace out the histories of the peoples who originated them. To a certain extent the work has been successful, but much still remains to be done in the direction of determining whence the people came and the part which the great land bridge between the two continents played in their migrations. Remains of the Neolithic or later Stone Age folk have been found in every part of Sicily. Some of the most interesting were exhumed by Palumbo from a crevice near Caltanisetta, and by Fiorini from the Montagna Grande near Palermo.

In 1890 a series of Neolithic caves was explored at Isnello in the province of Palermo. One cavern was nearly filled with human bones: the remainder contained an abundance of ornaments, stone weapons, and the ashes of cave fires. A cave was discovered in 1891 at Catania, containing the remains of a fire, a collection of mammalian bones, several human jaws, and a number of flint implements.

The origin of the flint offered some difficulty at first, as it was not then known to occur in any Sicilian formation. During a journey through Sicily in 1893 I traced it to the limestone deposits in the Val di Noto, and in the ravines at Modica and Ragusa, where it occurs interstratified with bands and concretionary masses of chert or phatanite in the Miocene rocks of the district. Proceeding westward to Sardinia, numbers of artificial caves, formerly used by the primitive Sardinians as tombs and dwelling places, occur in the sides of the hills and valleys. These caves vary greatly in size and character in different parts of the island, but among the natives they are known by the one name, domos di gianas. They are always found in proximity to the megalithic nuraghi, but they antedate these ruins by long ages, and belong at least to the later Neolithic period. The Neolithic races made their first appearance on the Mediterranean shores at the close of the Glacial, or so called Post-glacial period, and no evidences of an earlier existence either here or elsewhere have yet been forthcoming. Their predecessors, the Paleolithic folk, lived in southern

Europe during the later Pliocene and early Pleistocene times, that is, at the period when the greater portion of northern Europe was enveloped in a *mer de glace*.

These people were driven south by the intense cold, and they settled at many points around the Mediterranean. It is an interesting fact that though the remains of the Neolithic races are so plentifully distributed over the central Mediterranean area, no evidences have yet been forthcoming to show that the Paleoliths ever inhabited it.

A probable explanation of the absence of Paleolithic relics in the central Mediterranean region is afforded when the nature of the physical changes that occurred in the neighbourhood at the beginning of the Pleistocene period is taken into consideration. The Pliocene and Pleistocene deposits which envelop the lowlands and flank the highlands of southern France, Italy, Sicily, Malta and northern Africa, as well as the vast work of accretion which Etna has achieved during its comparatively short existence, afford some idea of the nature and magnitude of the forces that have acted on the area. The birth of Etna at the close of the Pliocene period was followed by the breaching of the land barrier which connected Europe with Africa, and its gradual subsidence beneath the invading waters. The changes were slow and tentative, and not of the nature of a cataclysm. The animals and plants of the land barrier were cut off from the mainland, and as their habitats gradually lessened in area so they died off, and left their remains to form the massive ossiferous agglomerates that now fill the caves, fissures, and ravines of Sicily and Malta.

Of the man of this period nothing is known, but it is possible that he recognised the danger of the situation, and, migrating, so escaped the fate which befell the remainder of the animal life of the district. He disappeared as mysteriously as he came, and the *débâcle* that finally swept the area and divided the continents was such as to remove every vestige of the old life, and every evidence of his occupation. His Neolithic successor experienced quieter times, and dwelt under conditions that were favourable to the preservation of his remains. Sicily and Sardinia are not the only places in the central barrier that have furnished evidences of pre-historic races. The Maltese Islands have, of late years, been carefully explored, and have added, if not an important at least an interesting quota to our knowledge of the subject.

In the early sixties the late Admiral Spratt and the late Professor Leith Adams carried on a series of investigations in the islands. The discovery of a stone weapon by Mr. J. Frere, F.R.S., in a garden at Villa Frere, near Valetta, attracted the attention of Adams, and for several years he gave special attention to the question of the occupation of the islands by pre-historic man. Professor Issel of Florence visited the islands in 1868, and, while superintending the excavation of a series of trenches in the Har Dalam cavern at Marsa Scirocco, he discovered, at a depth of four feet from the surface, the remains of a fire together with a collection of burnt mammalian bones and fragments of a coarse kind of pottery. It is to be regretted that for nearly a quarter of a century after the return of Issel to Italy no further steps were taken to follow up this discovery. In the years 1887 to 1894 it was my good fortune to make several additions to our knowledge of the extinct fauna of the district, and to discover further evidences bearing upon the history of the islands' early inhabitants. The more important discoveries were made in the Uied Har Dalam, a gorge which is situated on the eastern coast of Malta, and whose sides are perforated with a series of caves and fissures. The largest of these caves, known as Har Dalam, is more than half filled with a series of stratified floor deposits consisting of alternating layers of loam, ossiferous agglomerate, clay, stalagmite and boulders. These layers are arranged in two well-defined divisions, the lower of which is separated from the upper by a massive layer of stalagmitic conglomerate representing a period of time of considerable duration. In the lower division of the series was found a curious assemblage of jaws, tusks, teeth, and limb-bones of extinct elephants, hippopotami, bears, deer, wolves and giant dormice. In the upper occurred thousands of limb-bones, jaws, teeth, and antlers of deer, together with the remains of horses, dogs, ashes of domestic fires, fragments of a coarse kind of pottery, and the metacarpal bone of a human skeleton. These relics of the Maltese aborigines were found at several points in the cavern, but always at about the same horizon and in the upper division of the deposits. The latter fact is significant, as it agrees with the results of similar researches in Sicily, where no evidences of man have yet been forthcoming from deposits that were contemporary with the now extinct Quarternary mammalia. The different types of animals in the two divisions of the Har Dalam deposits, and the varying states of mineralization in which the remains occur, indicate that the divisions belong to two distinct epochs, and that a lengthy period of time intervened between them.

The reason of this must be sought for in the physical conditions under which the floor deposits of the cavern were laid down, and by which the gorge was deepened to its present level.

Probably no part of Europe has undergone such extensive changes in its configuration in recent times as the area now under consideration. The instability of the Mediterrancan floor has been many times demonstrated during the present century, as for example the inundations along the Italian coast, the upheaval of the Adventure bank off Sicily, and the submarine volcanic outbursts off Pantaleria in 1892.

A few years ago there was a tendency among geologists to call in the aid of cataclysms and other sudden operations of nature to explain geological phenomena; but of late the pendulum of geological thought has swung to the opposite extreme, and the doctrine of cataclysms has made way for that of the uniformitarian, who advocates the theory of slow progression as the effect of uncountable centuries of imperceptible movement. The area around Malta and Sicily affords abundant examples of both kinds of operations. The Har Dalam gorge, like most of the valleys and ravines of Sicily, Malta, Gozo, and Tunis, is bounded by rugged and precipitous cliffs, whose sides offer abundant evidences of the action of marine and river agencies.

Many of these gorges were probably initiated during the upheaval which the area underwent in early Pliocene times, and afterwards served as the main lines of drainage of the country. Their bottoms are frequently covered with boulder beds and breccias, and their sides are scored with smooth curvilinear groovings suggestive of the action of considerable bodies of running water.

The Har Dalam gorge was then probably a tributary of the river whose bed may still be traced along the sea bottom for several miles to the south-east of Malta. On the banks of this river the late Professor Leith Adams discovered the remains of freshwater turtles, swans, and other aquatic birds, together with immense quantities

of bones of elephants and hippopotami. This remarkable fauna existed at a time when the Maltese area formed a portion of the great Mediterranean land bridge, and when the climatic conditions of southern Europe were very different to those that now endure.

The present rainfall of the Maltese islands averages 17 inches, and it rarely exceeds 19 inches. The amount of water, therefore, that annually passes down the gorges to the sea has little or no erosive power, and is barely sufficient to remove the thin integument of soil which covers the bottoms in the higher reaches.

The question of the age of the Har Dalam cavern and its fossiliferous contents opens up an interesting field for investigation. The depth of the gorge is about seventy feet, and the cavern is situated at a height of forty feet from the bottom. The limited hydrographical area of the gorge renders it impossible, whatever the rainfall might be, to fill the gorge to a height sufficient to fill the cavern. The upper series of floor deposits were therefore laid down at a time when the gorge was very much shallower than it is now. It is hardly possible to express the antiquity of these layers in terms of written history, for the estimation of time by the rates at which rocks are denuded and built up is dependent upon so many variable factors that such chronometers are at best uncertain and unreliable. The Phœnician temples, tombs, and water tanks which are found in this gorge, at a level lower than that of the Har Dalam cavern, indicate how little the forces of erosion have effected since the time when they were constructed, about 3000 years ago.

Recent researches in the Nile delta have shown that two separate cultures existed prior to the advent of the Egyptian dynasties and Pyramid builders, thus giving a continuous history of 8000 years for man in Egypt. The ruder stages that characterize the Paleolithic and Neolithic periods in Europe are wanting around the Nile, but this is explained by the fact that the alluvial deposits of the Nile basin are not much more than 8000 years old. Observations have shown that during the last 8000 years the rate of deposition of Nile alluvium has averaged about one yard in a thousand years.

The borings indicate that the average maximum thickness of the Nile mud in the valleys is about eight yards, and this points to the conclusion that immediately prior to the time when the first layer of mud was formed, the rainfall was sufficient to fill the river valleys and prevent the deposition of the alluvium. The configuration and general physical features of the Egyptian Uieds and the Maltese gorges have much in common. The climatic conditions of the two areas are now, and probably always have been, similar. It is, therefore, probable that the work of gorge erosion was contemporary, and that the depth and extent of the Har Dalam gorge differ but little from what they were at the time when the great change in the climate set in. If it were possible to fix the exact time when the upper series of beds in this cavern was deposited, then the age of the stone implements and other relics of human industry which they contained would be determinable. It is not probable that this will ever be done. To do so it would be necessary to revert to a period when the streams that coursed down the gorge were of sufficient magnitude and power to rasp away the greater portion of the forty feet of hard semi-crystalline limestone that once lay between the mouth of the cavern and the present bed of the gorge. The time occupied by the waters of the stream in the work of corrosion and erosion must be added, and this, as has already been pointed out, is an indeterminable factor.

The evidences afforded by the Sicilian caves and the ossiferous loams of the Har Dalam cavern bring the solutions of the problem bearing on the migrations of pre-historic man in the central Mediterranean one step nearer. It is true the step is a short one, but the work of exploration proceeds apace, and the time will come when the gulf which at present separates the domain of the antiquarian from that of the geologist will be bridged by discoveries that will clear away the mist of uncertainty with which the subject is at present obscured.

Conducted by M. I. Cross.

Substage Condensers.—It is gratifying to observe the number of first-class substage condensers that are offered by manufacturers, and it is a distinct indication of growing knowledge and appreciation of good things on the part of workers.

It was at one time an easy matter to make a choice when only two or three systems were available, but it is evidently presenting some complexity now, and in response to correspondents enquiries we propose to give a few hints on the subject.

The main features of a condenser are: (1) *The achromatism*, (2) *aplanatism*, (3) *magnifying power*, and (4) *the size of the fixed lens.*

Achromatism and *aplanatism* can be considered together, but the latter is the more important. Recognising this, there is a tendency on the part of makers to claim greater aplanatism than is actually yielded; this can, however, easily be verified by the methods described in the text-books. Achromatism is a desirable quality, but we doubt the advantage of an apochromatic over an achromatic condenser; we would as readily work with the latter as the former provided the aplanatism were as well corrected, and this is frequently the case. Expense may therefore be avoided without loss of efficiency in this respect. The solid illuminating cone that an objective will bear has been frequently discussed. It is generally stated that three-fourths the full aperture is the best, but it will be found that the majority of lenses will not bear more than two-thirds without deteriorating in performance; there are some exceptional ones that will take more than a three-quarter cone, but this is not the rule, and a light filter is usually requisite.

The power.—The magnifying power of the condenser should not exceed half that of the objective, less rather than more than half is always preferable. Many systems are arranged to work satisfactorily with the front lens removed, and by this means high and low power effects are secured in one combination.

Size of field lens.—The reason for the popularity of the Abbe illuminator, with its glaring imperfections, is on account of its large field lens and the ease with which it can be worked. A high power condenser must of necessity have comparatively small lenses, and requires as great care in manipulating as the objective itself. The Abbe achromatic condenser was an attempt to maintain the easy working of the Abbe illuminator in a corrected form, but it is really too heavy and clumsy and restricts the movements of a mechanical stage. The best condensers have, as a rule, the largest field lenses that can be advantageously fitted, but this point is deserving of special consideration when making a decision.

Recommendations.—From the foregoing it will be possible, with given objectives and a maker's catalogue, to choose the most suitable condensers. If a man proposes to restrict himself to low and medium powers, not exceeding say $\frac{1}{6}$ in., he can readily make a choice, and we would like to specifically mention

the new condenser introduced by Mr. C. Baker, of 244, High Holborn: in this a specially large field lens is provided; the power ($\frac{4}{10}$ in.) is exactly the right one for histologists and workers with medium power objectives, while the aplanatic aperture closely approaches ·90. We have found it most effective in some work we have been doing recently, and great credit is due to the maker for its introduction.

The worker who does not go beyond an aperture of 1·25 can do all that his lens will permit with a dry condenser having the nominal aperture of 1·0 and yielding an aplanatic cone of ·90 as several of them do. If higher apertures are used, an oil immersion condenser is necessary. This advice has an appalling sound, but it is too little recognised that such systems can usually be worked dry, and will then give an aplanatic cone exceeding ·90. Such is the case with Watson & Sons' holoscopic condenser. Again, the top lens can be removed and a condenser of low power secured. Oil immersion condensers are too little appreciated, and it will be found, if it is desired to work with medium and high powers, that the oil immersion system will serve every purpose and is practically a universal condenser.

The Quekett Microscopical Club.—The practical work done by this Society, which was founded in the year 1865, is recognised as being of the first importance.

The meetings are attended by the foremost microscopists of the day. The journal, which is published bi-annually, and gives reports of the papers read and the proceedings generally of the club, is always worthy of careful perusal, but the great characteristic feature of the club is the welcome it extends to the amateur microscopist and the means it affords for bringing the novice into touch with the sound principles of manipulation, working and collecting.

On the first Friday in each month, a "Gossip" evening is held, at which specimens are exhibited by members and discussed conversationally, the regular business meetings of the society taking place on the third Friday in each month. There is, in addition, a first-rate library, and cabinet containing 6000 slides, which are at the disposal of the members.

We have before us a list of the excursions for the forthcoming season. These take place principally on Saturday afternoons, and have for their object the collecting of material that will afford interesting studies microscopically. "Pond life" has always been a very strong subject with the club.

Visits are cordially invited to the meetings, which are held at 20, Hanover Square.

When it is stated that all these advantages are offered without entrance fee for the modest sum of 10s. per annum, it will be conceded that every microscopist ought to make a point of becoming a member, and so supporting, in a practical manner, a club which has in the past and will continue in the future to promote the best interests of every feature in microscopy.

Communications on the subject of membership should be addressed to the Hon. Secretary, G. C. Karop, Esq., M.R.C.S., 198, Holland Road, W., or to the Hon. Editor, D. J. Scourfield, Esq., F.R.M.S., 63, Queen's Road, Leytonstone.

We hope, as the season advances, to give short reports of the excursions of the Quekett Club members, giving details of the material that is collected and the place where it is found.

Ringing Slides.—Many amateurs prepare and mount specimens remarkably well, but few manage to put the ring of cement on neatly. It requires practice certainly, but generally it is through using the cement in too thick a condition. Professional mounters have two bottles, one containing the cement, the other the solvent—generally turpentine or methylated spirits. The brush is first dipped in the solvent, then in the cement, and a thin coat is deposited on the slide as it is rotated on the turntable. Some build the ring up at once, others allow the first layer to dry and then complete the process: if there is sufficient time available the latter is the better way, but each time a fresh brushful of cement is taken, it should be preceded by a dip in the solvent. The cement can then be deposited with cleanness and regularity.

Lectures.—We have been applied to by a small Natural History Society for a lecturer or demonstrator, who would give an evening of practical explanation of the principles and working of the microscope and its appurtenances. We should be glad to know of one who would like to make himself useful in this way and to put him in communication with our correspondent. A fee would be paid if necessary.

Notes and Queries.—*Mr. A. Hubbard.*—The "chalk which you have been cleaning for Foraminifera is probably a manufactured article and consequently would be useless. Limestone from a cliff would be sure to yield the material you required. If you have not an opportunity of collecting this yourself, and will let me know, I shall be happy to send you a small quantity that would give you good results.

Communications and enquiries on Microscopical matters are cordially invited, and should be addressed to M. I. Cross, Knowledge *Office, 326, High Holborn, W.C.*

NOTES ON COMETS AND METEORS.

By W. F. Denning, F.R.A.S.

Comet 1898 VII. (Coddington).—This object, like the comets of Barnard (1892 V.) and Chase (1898 VIII.), was discovered by photography, and it remained visible for a considerable time. The observations, which number more than 400 in the aggregate, have been rigorously discussed by Mr. C. J. Merfield, of Sydney, and he gives definitive elements in *Ast. Nach.*, 3684-5. The comet passed its perihelion on 1898, September 14th, ·0442, and its orbit appears to deviate very slightly from that of a parabola.

The Discovery of Comets.—As far as is known there is at present nothing observable in the way of cometary objects. The small comet discovered by Giacobini in December last has now travelled beyond the range of our best telescopes, and the expected periodical comet of Brorsen has not yet been re-detected. But we shall probably not have long to wait for the discovery of new objects in this field, for March and April have been usually more productive than the winter months in furnishing them. No doubt many comets elude observation altogether, as the search for them is subject to many irregularities, and is very far from being exhaustive. The fact that a proportion of the known comets were found at times when they were long past perihelion, and were on the point of disappearance through increasing distance, warrants the inference that every year there are several small comets which visit our parts of space, and leave it without being sighted by those astronomers who make it their duty to search for these bodies. Some of the observers who have previously occupied themselves in this work have done exceedingly well, and established highly creditable records, but many additional hands are required to complete the thorough exploration of the sky month by month.

Fireball of November 27th, 1900.—This object was seen at 11h. 10m. by Prof. A. S. Herschel at Slough, Mr. H. Parsons at Leicester, and Mr. J. T. Cherryman at Plymouth. At the latter place the meteor appeared to be very brilliant and large, falling in a perpendicular direction from the Polar star. At Leicester the observer was startled by the passage of "a liquid mass of fire which illuminated the sky, and fell slowly in a dignified sweep towards the south-west by south." Several fragments broke away from the central mass during its flight. The radiant point of the meteor appears to have been at about 47° + 45°, and its height 57 to 17 miles over the region of Ilfracombe. Its visible path extended over 40 miles, and its velocity was about 18 miles per second. Prof. Herschel has also investigated the real path of this interesting object, and places the radiant at 50° + 45½°. He finds the heights 50 to 15 miles, the length of path 35 miles, and velocity 16½ miles per second. The radiant between α and β Persei is that of a well-known shower of slow meteors at the close of November and beginning of December, and we are fortunate to have secured such a brilliant example of them.

Fireball of February 13th, 1901.—At 10h. 41m. Prof. Herschel at Slough observed a fine meteor, equal to Venus, traversing a short course in Aries from 30° + 17° to 25° + 12½°. It fell low in the west, and was intercepted by the house roofs which formed the sensible horizon. The meteor imparted a strong white glare to the sky for a distance of about 10° around it, and it moved with moderate speed. The same object was seen at Clifton passing down the sky to the right of the Pleiades, from about 44° + 35° to 24° + 26°. It was very brilliant, but after a flight enduring two seconds, it passed behind houses near the W. by N. horizon. The probable radiant of the meteor was at 72° + 41°, near γ Aurigæ, and this is really the focus of a well-known shower between about February 5th and 15th. Its height was from 56 to 26 miles, and path about 36 miles over Pembrokeshire. These results are only approximate, and it would be useful to hear of other observations.

Fireball of February 27th, 1901.—Mr. Alex. Spark, of Aberdeen, reports an unusually brilliant meteor, at 8h. 45m., travelling in a N.W. direction. The colour of the head was bluish white, and it left a trail of reddish sparks. The fireball was also seen by an observer at New Deer, Aberdeen, at 8h. 53m., passing through Ursa Major, between the stars ϵ and ζ, and directed from between θ and 92 Leonis. It remained in sight 10 seconds. At Lerwick, in the Shetland Isles, Mr. A. Cadenhead noted the meteor at 8h. 51m., and describes it as

travelling through Cancer and Canis Minor, and disappearing in the vicinity of Orion. The height of the object was from about 103 miles over the North Sea to 57 miles over Stronsa, Orkney Isles, and its length of path about 120 miles. The radiant point was at about 165° + 6°, so the meteor was one of the τ Leonids which form a very active shower during the first few nights of March.

Large meteors are also reported as observed on the night of February 18th, on February 20th at 11.45 p.m., and on March 6th at 7.20 p.m., but very few descriptions have come to hand. Reports come from America that on Friday afternoon, December 7th, 1900, a brilliant fireball, rivalling the sun in the intensity of its light, passed above Colorado and Wyoming, frightening horses and cattle, and giving a loud detonation.

The April Lyrids.—This periodical shower will recur under favourable circumstances in 1901, the moon being new on April 18th, so that observations may be made between about April 10th and 25th. This system rarely furnishes a conspicuous display, but it is very interesting from its connection with Comet I., 1861. The radiant of the shower is at 271° + 33°, between Hercules and Lyra, and this point probably shifts somewhat rapidly to the eastward. Observations should be specially made to elucidate this feature. The immediate region of the radiant should be watched for long periods on several nights before and after the maximum (April 20th), and the exact place of radiation should be determined separately for each night.

THE FACE OF THE SKY FOR APRIL.

By A. Fowler, F.R.A.S.

The Sun.—On the 1st the sun rises at 5.38 A.M., and sets at 6.30 P.M.; on the 30th he rises at 4.37 A.M., and sets at 7.17 P.M. Sunspots are not likely to be either large or numerous.

The Moon.—The moon will be full on the 4th at 1.20 A.M., will enter last quarter on the 12th at 3.57 A.M., will be new on the 18th at 9.37 P.M., and will enter first quarter on the 25th at 4.15 P.M. The following are among the occultations which occur during the month:—

Date.	Name.	Magnitude.	Disappearance.	Angle from North.	Angle from Vertex.	Reappearance.	Angle from North.	Angle from Vertex.	Moon's Age.
				°	°		°	°	d. h.
Apr. 4	B.A.C. 4531	5·7	11.59 P.M.	97	104	1.18	311	304	15 11
,, 8	ω^2 Scorpii ...	4·6	3.59 A.M.	81	71	5.19	288	267	18 15
,, 8	ω^1 ,, ...	4·1	4.5 A.M.	16	5	4.20	356	342	18 15
,, 22	χ^2 Orionis ...	5·9	10.25 P.M.	71	32	11.11	305	269	4 1
,, 27	19 Sextantis	6·0	7.40 P.M.	168	170	8.31	247	238	8 23

[On May 3rd there will be a penumbral eclipse of the moon, from 4.6 P.M. to 8.55 P.M. As the moon does not rise until 7.28 P.M., the eclipse is only partly visible at Greenwich.]

The Planets.—Mercury is at greatest westerly elongation of 27° 48′ on the 4th, and is a morning star throughout the month. He is not well placed for observation in our latitudes.

Venus is nominally a morning star, but is too near the sun for observation. She will be in superior conjunction at the end of the month.

Mars remains in Leo and may be observed throughout most of the night, setting on the 30th at 2.45 A.M. At the middle of the month he crosses the meridian at 8.15 P.M., and the illuminated part of the disc is 0·924. The apparent diameter diminishes from 11″·4 to 9″·0 during the month.

Jupiter is a morning star, in Sagittarius, rising on the 1st at 2.19 A.M., and on the 30th at 12.29 A.M. He is in quadrature with the sun on the morning of the 2nd, and stationary on the 30th.

Saturn is also in Sagittarius, a little to the east of Jupiter. He rises on the 1st at 2.32 A.M., and on the 30th at 12.40 A.M. He is in quadrature with the sun on the 6th, and stationary on the 26th.

Uranus is in the most southerly part of Ophiuchus, 4° to the north-west of θ about the middle of the month. The planet rises on the 1st at 12.31 A.M., and on the 30th at 10.35 P.M.

Neptune remains in the most easterly part of Taurus setting on the 1st soon after 1 A.M., and on the 31st soon after 11 P.M. During the month he describes a short easterly path almost midway between χ^1 Orionis and 132 Tauri.

The Stars.—About 9 P.M., at the middle of the month Leo will be on the meridian; Gemini in the south-west; Orion in the west; Virgo in the south-east; Hercules in the north-east, and Ursa Major almost overhead.

Minima of Algol will occur on the 2nd at 8.23 P.M., and on the 22nd at 10.6 P.M.

Chess Column.

By C. D. Locock, B.A.

Communications for this column should be addressed to C. D. Locock, Netherfield, Camberley, and be posted by the 10th of each month.

Solutions of March Problems.

(C. D. Locock.)

No. 1.

1. Q to B4, and mates next move.

No. 2.

1. R (R3) to Rsq.

No. 3.

1. B×QP.

[This has been rather ambiguously described as "a taking key." The P at R6 was left on the board by mistake. In a former version of the problem it was necessary to prevent a solution by 1. R to Q7ch, and 2. Q to R6.]

C. L. Massey.—I can find no trace of any statement in Knowledge to the effect that problems known to have more than one key would not be printed. While agreeing with you that the search for a second key is generally profitless, and sometimes vexatious, I may, perhaps, point out that such search often discloses the hidden art of the composer in avoiding "cooks," which might otherwise have escaped the solver's notice. But the principal reason for allowing an extra point for a second solution lies in the fact that, without some such device for differentiating skilful solvers, the prizes and credit would probably have to be divided among some twenty or thirty solvers at the end of the year, a result which would hardly be regarded as satisfactory. As it is, competitors are at least spared the necessity of looking for a third or fourth key after a second has been found, an obviously time-wasting condition which holds good in most solution tournaments.

J. Baddeley.—I have written to enquire into the cause.

W. Jay.—No. 2, as you point out, would be impossible in actual play. The dual you mention in No. 3 seemed unavoidable.

B. Harley.—The Pawn at B2 in No. 3 prevents a dual which would exist if the Black Pawn which it blocks were allowed to move.

N. L. Gillespie.—No. 1. If 1. K to Kt4, P to Kt4 (or K moves). No. 2. 1. P×P, B×Pch.

A. W. Tyer.—No. 1. If 1. B to B7, B to B5, No 2. See previous answer.

H. S. Brandreth.—No. 1. If 1. P to Q3, B × P. No. 2. If Q to R4, P × Pdis. ch.

W. F. P. and *J. A. Nicholson.*—See answer to H. S. Brandreth.

C. F. P.—"The Two-move Chess Problem," by B. G. Laws, would probably suit you.

C. S. Hudson.—No. 2. If 1. B to Q3, KtP moves.

F. V. Wilhelmy.—Your solutions last month (correct) were received on the 15th, after this page had gone to the printers.

J. W. Meyjes and *Alpha.*—Several competitors, like yourself, are still solving without any idea of "competing."

H. W. Elcum.—The fallacy of course is obvious enough, the only difficulty consisting in calculating the area of the "gap." I do not follow your argument which gives an area of 81 for the rectangle.

F. T. Mott.—Too late to reply to last month. P to Q3ch was incorrect.

SOLUTION TOURNEY.

The following are the leading scores up to date:—

Seventeen points.—S. G. Luckcock, J. T. Blakemore, G. W, C. Johnston, A. C. Challenger, A. Dod, W. Jay, S. W. Billings.

Sixteen points.—J. Baddeley, H. le Jeune, B. Harley, G. Groom, F. J. Lea, W. de P. Crousaz, W. H. S. M., N. K. Dutt, Endirby, F. Dennis, C. C. Massey, Eugene Henry, A. J. Head, J. Sowden, G. W. Middleton, E. Hunt, Vivien H. Macmeikan, A. E. Whitehouse, J. E. Broadbent, C. Child.

Fourteen points.—G. A. Forde (Capt.), A. H. Machell Cox, Alpha, H. Boyes, C. F. P.

Thirteen points.—J. M. K., W. Nash, C. C. Pennington.

Problem No. 3 was correctly solved in all cases. No. 1, on the other hand, claimed five victims, and No. 2 nine.

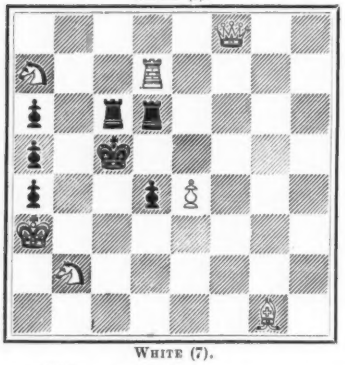
In reference to the Chess Puzzle given in the last number, E. J. P. points out that whereas the gradient from C to A is obviously two in five, or 16 in 80, that from B to C is only three in eight, or 15 in 80; which clearly shows that A C and C B are not in the same straight line. The same of course applies to B F and F A.

PROBLEMS.

By P. G. L. F.

No. 1.

BLACK (7).

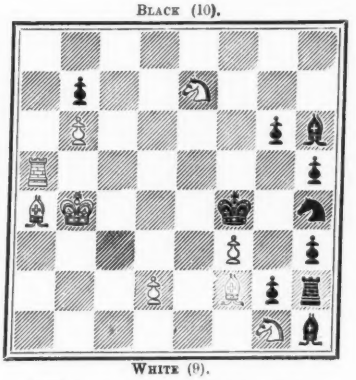


WHITE (7).

White mates in two moves.

No. 2.

BLACK (10).



WHITE (9).

White mates in three moves.

CHESS INTELLIGENCE.

The prize-winners in the recent International Tournament came out in the following order:—1, D. Janowski, 10½; 2, C. Schlechter, 9½; 3, Von Scheve, 9¼; 4, M. Tchigorin, 9; 5, S. Alapin, 8¼; 6, J. Mieses, 7. M. Janowski's victory shows that he has completely recovered the form which he had evidently lost at the Munich Tournament last summer, when he could do no better than tie for the seventh and eighth prizes. Herr Schlechter on that occasion tied for the first three prizes with Mr. Pillsbury and Herr Maroczy. In the present tournament he has done equally well, and by his consistent form has proved his claim to be considered one of the first five players of the day. Herr von Scheve, who has been an absentee from tournaments for the past ten years, did far better than he has ever done before. Of the other veterans neither Herr Winawer nor the English representatives did very well, though Mr. Blackburne came out next to the prize-winners, and Mr. Gunsberg at one time seemed certain to secure a place. Mr. Marshall has not sustained his reputation, already considerably dimmed by his recent performances in America. Signor Reggio, the winner of the recent Italian National Tournament, made a very promising first appearance, and is evidently considerably stronger than Vergani, the Italian representative at Hastings in 1895.

A Russian National Tournament held at Moscow had previously resulted in the victory of M. Tchigorin, E. Schiffers being second, and D. Janowski third. The latter evidently derived some benefit from the practice obtained on that occasion.

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